Impact Of Energy Development Activities And User's Needs - A Case Study

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1. BACKGROUND

1.1 Introduction

Energy development forms a significant part of rural development programmes. Need for increase in energy supply and the existing shortage of electricity, biofuels and liquid petroleum fuels calls for conservation of energy and use of renewable energy forms. Consequently, greater emphasis is being given to more optimal use of local energy sources in villages. The Planning Commission has been promoting methods of Integrated Rural Energy Planning (IREP). The Department of Non-Conventional Energy Sources has been undertaking programmes like NPBD (National Programme on Biogas Development), NPIC (National Programme for Improved Cookstoves) and development of Urja Grams for promoting the use of alternative sources of energy in rural areas.

The response of the concerned communities to these energy development activities depends on the current development level of these communities and their perceived needs. To develop an appropriate approach therefore, it is essential to understand the energy development issues in different village categories, i.e. a backward village where even basic amenities of food, water, shelter, primary education and health services are not easy to get; in a village at a medium level of development where there is an access to other facilities like electricity, education etc.; and in a developed rural environment where these facilities are available and urban linkages are fairly developed.

The Tata Energy Research Institute conducted a study in a village, Dhanawas in the Gurgaon district of Haryana in 1984 to

develop a suitable approach for energy development in a relatively developed rural community. Surveys were carried out in the village to collect primary data on the energy consumption and supply situation in the village, followed by demonstration of solar devices, biogas plants and improved cookstoves in the households. An energy plantation was also started on the Panchayat wasteland. A local body for management of the energy systems and a Village Energy Development Committee was formed which further increased the involvement of the villagers.

After two years, in March 1987, a survey, "Activity Impact and User Need Survey" was carried out to get the feedback from the villagers. Characterized by its direct relation with the extension work, this survey marked an important step in the expansion of dissemination activities in the village. Here, we present the methodology of survey and discuss the findings of the survey along with their usefulness in planning further extension.

1.2 The Village

The village Dhanawas is in the Gurgaon district of Haryana state 14 km from Gurgaon. The nearest town, Faroukhnagar is 7 km away from the village.

As per the study conducted in 1987, the village consists of 144 families with a total population of over 1000. Majority of them are Ahirs with Harijans constituting only 10% of the population.

The village has a primary school, most of the children go to nearby villages for further education. While agriculture is the main occupation of the village, a number of people are in service in the nearby towns (Table 1.2.1).

Table 1.2.1: Profile of village Dhanawas in 1987

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1. Identification

Village : Dhanawas — District : Gurgaon
Block : Faroukhnagar — State : Haryana

2. Demography

No. of households : 144 — Population : 1006

Occupation (hh) :

Agriculture	: 67	Labour	: 15
Service and Agriculture	: 25	Agriculture	
Service/self employment	: 33	and labour	: 4

Dwelling Type: Mostly of brick or stones with concrete with a few kutcha houses

3. Services

Electricity : Grid supply for agriculture and domestic use with 91 domestic connections.

Water : Piped drinking water supply from Kettawas, a nearby village

Education: Primary school — Primary Health Centre: Nil

Post Office in Wajirpur: 3 km away — Bank: Syndicate Bank in Wajirpur 3 km away

4. Animal Population

Buffaloes	: 151	Goats	: 5
Cows	: 70	Camels	: 3
Bullocks	: 36	Poultry	: 4175
Calves	: 215		

5. Land

Type of soil: Sandy clay

Type of land (acres):

Cultivable	: 682	Private Wasteland	: 31
Forest	: Nil	Panchayat Wasteland	: 105

Land distribution among farmers (acres):

Large	: 452 (25 hh)	Small	: 92 (25 hh)
Medium	: 134 (19 hh)	Marginal	: 41 (27 hh)

Table 1.2.1: Profile of village Dhanawas in 1987 (Contd)

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6. Crops

Rabi :

Total area cultivated: 611 acres

Percentage area under different crops:

Wheat	: 41	Barley	: 15
Mixed	: 21	Gram	: 6
Mustard	: 17		

Kharif

Total area cultivated: 305 acres

Percentage area under crops:

Jwar (Sorghum)	: 34.5	Bazra	: 6.4
Guar	: 23.5	Ground Nut	: 1.9
Mixed	: 25.2	Others	: 3.5

7. Irrigation

Land under irrigation : 719 acres

Source : Ground water

Lifting devices:

Electric pumpsets	: 63	Persian wheels	: 3
Diesel pumpsets	: 27		

8. Fuels

Non-commercial

Dung cakes	Guar stalks
Mustard stalks	Twigs
Biogas	

Commercial

Kerosene	Electricity
Wood	Diesel
LPG	

Note: hh - households

The houses in the village are mostly made of bricks or stone, though some are made of mud with thatched roofs. About

64% of the households have electricity. The village gets piped water supply from a neighbouring village for limited hours every day. The nearest bank and post office are about three km away.

1.3 Need for Energy Development

Primary level surveys were conducted to understand the prevailing pattern of energy use in the village. To observe the seasonal changes in supply and consumption, two census surveys were conducted: in May-June, 1984 and in September-October, 1985. The surveys identified the household and the agriculture sectors as the two main areas of energy consumption. For both these sectors the energy supply and consumption was quantified in various end-uses, according to fuel-sources for different economic categories.

In the domestic sector, biomass fuels for cooking accounted for more than 97% of domestic energy consumption (Table 1.3.1). For all the categories of households, dungcake was found to be the main cooking fuel followed by crop residues (mainly mustard stalk). Estimates of biomass availability also showed the unequal distribution of crop residues and cattle dung.

Data on livestock showed that 83% of the households in the village have cattle with an overall average of 3.5 cattleheads per household. This average varied widely from 6.6 for rich farmers to 2.2 for landless households, with the average of about 65% households having more than two cattleheads.

Table 1.3.1: Monthly household energy consumption per family

Unit: 10^3 kcal

HH category	Total energy consumed per hh (10^3kCal)	Biomass fuels				Non-biomass fuels			Total	
		Dung cake	Firewood		Crop-residue	Coal	Kero-sene	Elect-ricity	Biomass	Non-Biomass
			Logs	Twigs						
Large	3554.81	2153.43 (61)	7.92 (<1)	156.67 (4)	1190.00 (33)	-	25.17 (1)	21.62 (1)	3508.02 (99)	46.79 (1)
Medium	3107.79	2242.20 (72)	-	-	807.69 (26)	-	42.73 (1)	15.17 (<1)	3049.99 (98)	57.90 (2)
Small	2326.00	1239.73 (53)	101.79 (4)	275.79 (12)	672.50 (29)	-	19.13 (1)	17.02 (1)	2289.81 (98)	36.19 (2)
Marginal	2028.52	1134.44 (56)	-	134.29 (7)	705.00 (35)	16.49 (1)	22.59 (1)	15.39 (1)	1973.73 (97)	54.46 (3)
Landless	2117.52	977.36 (46)	43.08 (2)	561.70 (27)	464.69 (22)	12.75 (1)	38.54 (2)	19.40 (1)	2046.83 (97)	70.69 (3)
All	2473.59	1377.41 (56)	35.63 (1)	307.29 (12)	696.90 (28)	7.71 (<1)	30.54 (1)	18.11 (1)	2417.23 (98)	56.36 (2)

Note: Figures in parentheses indicate percentages of the total.
hh = household
Source: (2)

In agriculture, rabi and kharif were the two cropping seasons. Rabi was more important of the two with wheat, barley and mustard as the major crops. Guar, bajra and jwar were the main kharif crops.

Water pumping accounted for the bulk of the energy consumption (70%) in agricultural sector. Electrical energy input was marginally higher over diesel although the village had 60 electric and 15 diesel pumpsets. Diesel consumption of tractors used in land preparation accounted for more than 25% of energy consumed in this sector. The animal and human energy used in agriculture was not considered in the survey.

Cowdung is the major energy source (49%) followed by crop residue (25%). Cooking and water heating activities together consume more than 86% of the total energy. Share of irrigation in the total energy consumption is only 5%.

Table 1.3.2: Energy input in agriculture sector (rabi)

Activity/ source of energy	Unit	Quantity	kcal 10^3	Percentage share
Pumping				
Electricity	kWhr	145428	125.2	37
Diesel	lt.	13570	117.2	35
Total			242.4	
Threshing				
Electricity	kWhr	6640	5.7	2
Diesel	lt.	150	1.3	< 1
Total			7.0	
Tractor				
Diesel	lt.	10136	87.5	26
Total energy consumed in Rabi (minus energy for threshing)		:	329.9 10^3 kcal	
Total area cropped		:	513 acres	
Average energy consumption		:	643 kcal/acre	

Source: (2)

Considering the current pattern of energy consumption, the main energy development needs of the village were identified to be

(i) Increased energy supply.

(ii) An improvement in quality of energy in use and energy conservation.

(iii) As cooking was the main energy consuming activity, it was felt that by promoting use of improved cookstoves there was a scope for energy conservation.

(iv) High livestock population and extensive use of cattle dung as fuel also offered a potential for use of biogas.

(v) For increase in fuel supply, biomass development could be undertaken through plantations on wasteland and through agroforestry. The panchayat has about 105 acres of wasteland.

(vi) The solar energy could be utilized for thermal application.

1.4 Preliminary Dissemination

With the above requirements in view, following activities were initiated in the village on a demonstration basis.

i) Development of the Panchayat wasteland

The plantation work was started in July 1984 on 20 acres of Panchayat wasteland, with the objective of improving the fuelwood supply to the villagers and reclamation of the wasteland. The species planted included

1. Prosopis juliflora (Vilayati kikar)
2. Eucalyptus hybrid (Safeda)
3. Acacia nilotica (Kikar)
4. Dalbergia sissoo (Shisham)
5. Azadirachta indica (Neem)
6. Leucaena leucocephala (Subabul)
7. Albizzia lebbek (Kala siris)

The plantation did not show very encouraging results due to high salt content in the soil and water logging, Thus a fresh plantation was undertaken in a part of the land in February and July '87 with the following species.

1. Acacia nilotica var cupressiformis (Ramkanti babul)
2. Pongamia pinnata (Kanji)
3. Terminalia arjuna (Arjun)
4. Albizzia lebbek (Kala siris)
5. Sygygium cumini (Jamun)
6. Cassia siamea (Avaram)
7. Albizzia procera (Safed siris)
8. Dendrocalamus strictus (Bamboo)
9. Acacia auriculiformis
10. Albiozzia amara
11. Parkinsonia
12. Casuarina equisetifolia (Casuarina)

ii) Demonstration of energy saving devices viz.

a) Solar cookers and solar water heaters

b) Improved cookstoves

c) Biogas plants

For introducing the solar technology, six box type solar cookers and two units of a TERI designed water heater were given on demonstration. Subsequently, a nocturnal water cooler and five units of another kind of solar water heater were also installed. None of these devices was found to be suitable for the village. Solar cookers did not find much appeal in the village mainly because rice is not the staple food of the area. Out of six cookers given, only two households used the cookers occasionally. Nocturnal water cooler, which had been installed in a place of common use, was discarded as nobody took the responsibility for taking care of it. Its performance was

similar to that of a mud pot and was not very effective. Among the water heaters, only one design performed satisfactorily. However, its maintenance requirement was quite high which was essentially taken care of by TERI professionals. Since the cost of these water heaters was also so high (about Rs. 1,000/-), large scale dissemination of these devices was not attempted.

The programme on dissemination of improved cookstoves included demonstration and dissemination of two kinds of improved chulhas (cookstoves): TARA - a portable metal chulha and Nada - a mud chulha with chimney selected on the basis of suitability. The metal stove TARA was given for demonstration first and later, it was put on sale at a subsidized price. The chulha found a wide acclaim in the village and within eight months 96 chulhas were sold in the village. For the mud chulha, Nada, a demonstration programme was carried out with construction of 10 chulhas for the interested households to study the response.

For introduction of the biogas technology, a family size fixed dome biogas plant (2 cu.m./day capacity) was constructed for an interested farmer. TERI provided a subsidy on the plant in addition to the Government subsidy. This was followed by construction of two more similar plants.

For about two years, the extension work was carried out mainly through informal interaction with the Sarpanch and villagers. Later, it was considered desirable to form a body in the village which could help in more active and organized participation of the villagers in TERI's activities and could slowly take over the management of energy systems in the village.

Thus, a Village Energy Development Committee was formed with five members from the village and two from TERI. This committee was to act as a forum for discussions and taking decisions on matters related to extension activities in Dhanawas. Committee members were expected to help TERI in taking up activities which could be useful to the village and in turn keep the villagers informed of TERI's work. A bank account was also started jointly in the name of the committee and TERI for depositing the money which could be gathered from any energy activities in the village. The TARA chulhas were sold in the village through the committee. The money collected from their sale was put in the committee's account and was later used for installing a hand pump in the village temple on the advise of committee members. The committee members also helped in the selection of households for installation of biogas plants, solar water heaters and selling chulhas. These energy related needs were identified during various committee meetings - i) improvement in Hara; ii) improvement of pumpsets; and iii) development of private wasteland.

When some of the energy technologies had been demonstrated in the village and the villagers had started responding to them, a need was felt to assess the impact of extension activities carried out till then and gauge the potential for their expansion. It was considered essential for the TERI professionals to have a direct contact with the households to get a perspective of the needs perceived by them through a house-to-house survey themselves.

2. THE ACTIVITY IMPACT AND USER NEED SURVEY

In view of the nature of information to be collected, the survey planned for the purpose was termed as the "Activity Impact and User Need Survey" (AIUN Survey). As it was being undertaken after the initiation of extension activities and was related directly to the extension work, the survey was considered as the second level survey in contrast to the first level surveys which addressed themselves mainly to the existing pattern of energy consumption.

2.1 Objectives of the Survey

The specific objectives of the AIUN survey were identified as follows:

i) To assess the potential for dissemination of various technologies.

ii) To determine the scope of technology utilization and users' experience.

iii) To collect specific information about resource base necessary for dissemination of technologies.

iv) To create awareness of TERI activities. v) To get the opinion of people on TERI's activities.

vi) To explore the possibility of introducing new technologies.

2.2 Methodology

The survey was conducted by the TERI professionals in the village. To ensure that each household was aware of TERI's activities, it was decided to give them brief write-ups at the time of conducting the survey.

2.2.1 Questionnaire

The questionnaire was designed keeping in view the objectives of AIUN survey and areas of TERI's interest. The questionnaire was prepared in the local language Hindi and it was divided into two separate parts for men and women based on their prevalent role in the family. Men's part of the questionnaire covered

i) **General information about the family:** This included number of members in the household in various age-groups, annual income, land owned and the devices installed by TERI in that household.

ii) **Biogas technology:** This section covered the financial resources, cattle population, land availability and willingness of the household to install a biogas plant.

iii) **Agriculture:** This covered

   a) Information on crops grown at different times of the year, extent of land use, irrigation and fertilizer requirements of each crop and details about leaving the land fallow and extent of dependency on government agencies.

   b) Willingness of the farmers to practice agroforestry i.e. plantation of trees along with the crop, and if they perceived the need for a nursery in the village.

   c) Details of wasteland owned by the household, their inclination to spend time and money for its reclamation, and existing infrastructure such as pumpsets for irrigating the land.

iv) **Pumpsets:** This included information on the type, make, horsepower and year of purchase of the pumpsets owned by

the household as also area irrigated by it and annual expenditure on its operation and maintenance. With a view to take-up a project on improvement of pumpset efficiency, questions on their plans to buy a new pumpset or get the old one repaired, were also incorporated.

v) **Crop residues:** In this section, the amount of different crop residues available and their use was to be ascertained. This was to determine the possibility of alternative uses of surplus biomass.

vi) **Employment/training:** Here information was obtained about the occupation of the male members of the households, their qualification and their interest in getting trained for maintaining/installing any of the technologies being introduced by TERI or help TERI in its activities in the village.

vii) **Awareness about TERI's activities:** To find out the extent of awareness among the villagers about the Village Energy Development Committee and their willingness to involve themselves in TERI's activities through the committee questions were included to determine specific expectations from TERI as regards their needs and problems.

Women's part of questionnaire included:

i) **General information about family:** This mainly covered the number of females in different age groups. This was included so as to get information on girls/women in the household who could be potential trainees or helpers in TERI activities.

ii) **Improved Cookstoves:** This included response of the users to both the cookstoves - TARA as well as Nada. For those who did not have one or both the chulhas, questions were framed to determine their willingness to have them and if unwilling, reasons for the same were also to be found.

iii) **Biogas technology:** Here number of cattleheads in a family, where they were kept in different seasons and inclination of the womenfolk to have a biogas plant were to be determined.

iv) **Cooking fuels:** This was to establish the availability of different biomass fuels in different seasons and to find out the problems faced by the household in getting the fuel in a particular season.

v) **Employment/training:** This was mainly to find out the potential trainees for Nada chulha construction.

vi) **Awareness about TERI's activities:** As in the men's part, questions in this section pertained to the awareness of the households about TERI's activities and the Village Energy Development Committee.

The questionnaire did not include any queries related to solar devices as the past experience showed that these devices did not have any significant potential in the village. Before finalizing the questionnaire, it was circulated among the committee members of the village for comments. No concrete suggestions were made.

2.2.2 Write-ups

In order to increase the awareness of the villagers about TERI's work, write-ups were prepared to be given to the villagers during

the survey. They were written in Hindi and consisted of the details of various activities undertaken by TERI and their benefits to the village. Information about the following was covered in the write-ups.

i) The Village Energy Development Committee
ii) TARA chulha
iii) Nada chulha
iv) Biogas
v) Agroforestry
vi) Wasteland development

As it had been decided not to disseminate solar devices, no write-ups were prepared on them.

2.2.3 Identification of Households

The first level surveys were based on the census list according to which there were 127 households in the village. However, the census list did not consider division of families within the household and consequent existence of separate kitchens in the same house (The term `kitchen' is used here as a separate cooking infrastructure and not necessarily a physical structure). As each family with a separate kitchen was a potential household for cookstoves and biogas plants, for the AIUN survey a new list was prepared considering each family cooking separately as one household.

A map of the village corresponding to these households was also prepared with the assistance of committee members for easy identification of houses during the survey. A total of 154 households were identified during the mapping stage. However,

during the actual survey. Only 149 kitchens were identified in the village. Out of these 5 families were cooking separately but their property i.e. land and cattle was combined with that of parent farmers. Thus from the consideration of land-owned, there were 144 households in the village.

2.2.4 Method of Conducting the Survey

One of the main aims of AIUN survey was to have a direct contact with the villagers to make them aware of TERI's activities and motivate them for participating in them.

Hence a team of TERI professionals stayed in the village for a week to conduct the survey. Two village boys and a girl were also hired for assistance during the survey.

The methodology adopted was as follows:

i) Each TERI professional with a village assistant constituted one survey group. A copy of the village map with households numbered and the corresponding household list was given to each surveyor for reference. In order to maintain the consistency in data collection, an instruction sheet was prepared and given to each surveyor. An advance plan on the households to be covered by each surveyor on the next day was made.

ii) Men's and women's parts of the questionnaire were filled up separately. While the survey groups with male members of TERI staff covered men's section, the women's section was handled by the female staff members.

iii) The surveyors visited each household and filled in the questionnaire in accordance with the answers given by the

respondent. While for men's part, efforts were made to record the responses of the household head, for women's part, care was taken to get the responses from a responsible female member of the family. For the section on employment, either the members above the age of 16 were contacted individually or necessary information was obtained through other family members.

iv) At the time of conducting the survey, a copy of the write-ups was given to the male members of the family besides oral explanation of the activities. Women were explained about TERI's chulha and biogas programmes and the Village Energy Development Committee. The literate women were also encouraged to read the write-ups given to the men folk.

The village assistants mainly helped in physically identifying the houses corresponding to the map and the household list. Since the survey was conducted at the time of harvest most of the people were available in the fields at day-time. The assistants were of great help in going to the respective fields. Their presence also facilitated a better communication with the households.

In order to comply with the time-schedule, the village assistants were asked to make sure of the availability of the respondents to be covered in a day.

2.3 Data Analysis

As the information collected during the survey was both qualitative and quantitative, it was considered desirable to analyze the data manually. This also helped in later clarifying some of the information collected in specific households.

An economic classification of all the households was carried out by the analysis for all the sections. As the response of the households had been recorded by the TERI professionals, inconsistency could be minimized. In the event of discrepancy, the information was rechecked from the household. This was particularly true for the data on pumpsets where two or more households were found to be sharing a pumpset. Any disparity in cases where there was repetition of data, the data which seemed more reliable and logical was considered.

3. ACTIVITY IMPACT AND USER NEED SURVEY - RESULTS AND DISCUSSIONS

As indicated earlier, Activity Impact and User Need Survey had been undertaken to collect information needed for further extension in the village. This information could be classified into four main categories: the resource base, potential for energy development activities, training and employment potential and general response of villagers towards TERI's activities. All the households in the village were classified with respect to their occupation and economic status. The data collected under different sections was then analyzed with reference to the different economic categories.

3.1 Classification of Households

It was essential to classify all the village households into economic categories as the strategies adopted for any dissemination programme largely depended on the economic status of the beneficiaries. Further, it was considered desirable to identify the economically weaker households in the village as against economically well-off ones to enable us to ensure their involvement in TERI programmes.

Classification of the households is commonly done either on the basis of land-holdings or the income declared by the households. However, neither of these two criteria can, by itself, truly represent the economic status of the family in a village like Dhanawas due to the following reasons:

i) Experience shows that income figures as given by the farmers are not reliable.

ii) The classification based on land-holdings does not account for the fact that a number of landless people are in service or are self-employed and hence may not be economically backward. In farmer families as well, some members may be in service and thus adding to the income.

To overcome the above shortcomings and in order to arrive at a more realistic economic classification, it was decided to consider both the income and the landholdings. Income from agriculture (which is a seasonal income) as reported by the household was found to be quite unrealistic (in most of the cases it was given to be too low), whereas figures of income from the more regular sources like service, business or masonry etc. were more reliable. Thus it was decided to make two broad categories of the households: i) households having agriculture as the only occupation and ii) households in service or self-employed with or without any land holdings. The households in the first category were classified further on the basis of land holding. In the second category, classification was done considering the land holding and the income from all means. Finally classification in both the categories was combined to identify the economically well-off and weaker sections in the village.

Category 1: This consisted of households which had agriculture as the only occupation (considering the household head only). To further classify the households in this category, greater of the following was considered:

i) Cultivable land owned by any household

ii) Land being cultivated by that household (land being cultivated = owned + leased in - leased out)

This was done to take into account the income from land taken on lease to both lessee and lessor. Waste land was not considered as it was not providing them any income. Table 3.1.1 gives the classification of farmers in this category.

In the household list based on the separate kitchen, 72 families of farmers were identified of which five were cultivating land with their fathers. Thus, 67 households were identified on the basis of the land they owned.

Category 2: This category of households were in service, were self-employed (businessmen/artisans) or were doing labour with or without any land-holdings. Here the classification was based on the cultivable land owned or under cultivation, whichever was greater and the declared income from sources other than agriculture.

Households were grouped under different combinations of annual income from the sources and land owned/under cultivation (Table 3.1.2). In Category 2, as many as 29 households (20% of total number of households) had other occupations besides agriculture. Even among landless people, a significant number had annual income > Rs. 5,000. To combine the two classifications into single one, economically well-off and economically weaker sections were identified in both the categories.

Table 3.1.1: Classification of households in category 1

Type of household	Cultivable land owned/under cultivation	No. of households
Large Farmers	>10 acres	25
Medium Farmers	5-10 acres	17
Small Farmers	2.5-5 acres	14
Marginal Farmers	up to 2.5 acres	11
Total		67

Note: The interval includes the upper limit but not the lower limit.

Table 3.1.2: Classification of households in category 2

Land owned Under cultivation (acre) / Annual Income (Rs.)	No. of households 0	<1	1-2.5	2.5-5	5-10	>10	Total No. of hh
< 500	1	-	-	-	-	-	1
500-1,000	1	-	-	-	-	-	1
1,000-2,000	8	1	3	-	-	-	12
2,000-5,000	15	-	2	1	-	-	18
5,000-10,000	12	6	2	2	-	-	22
> 10,000	11	1	3	7	1	-	23
Total	48	8	10	10	1	-	77

Note: The interval includes the upper limit but not the lower limit
hh = household

In category 1, small and marginal farmers (with land holdings up to 5 acres) were considered as economically weaker

whereas large and medium farmers were identified as economically well-off.

In category 2, the households falling within the marked boundaries in Table 3.1.2 were identified as economically weaker i.e. those with no land holdings or land holding up to 1 acre and an annual income of up to Rs. 5,000 and those with land holdings up to 2.5 acres and an annual income of up to Rs. 2,000.

Table 3.1.3: Classification of households into economically well-off and weaker sections

Economic Category	Type of household	Total No. of hh
Economically Well-off	Large farmers	25
	Medium farmers	17
	Farmers with additional occupation	25
	Landless house-holds in service/ self-employment	23
Economically Weaker	Small/marginal farmers	25
	Farmers with additional occupation	4
	Landless house-holds in service/ self-employment/ labour	25
Total		144

hh = household

In the final classification, the households were grouped into the two broad categories of economically well-off and economically weaker sections. Table 3.1.3 summarizes the final

classification. This way a total of 54 households (35% of the total families in the village) were identified as economically weaker.

3.2 Resource Base

This covers the data on livestock, domestic fuels and agricultural resources.

3.2.1 Livestock particulars

Data on livestock was to be collected mainly for assessing the biogas potential. The information on livestock is presented here and its correlation with biogas potential is dealt with in the section on biogas.

Though information on household-wise cattle population was available even from the earlier surveys, more detailed information was sought to assess variation of cattle population in the village and to examine the reasons of fluctuation in cattle population in a household.

Livestock distribution

Table 3.2.1 gives the distribution of different types of livestock among different categories of households. Average number of cow equivalents per family given in the last column of the table was calculated by converting all the animals into their cow equivalents on the basis of dung availability. This was done by finding out the dung availability from an animal (Table 3.2.2) and dividing it by the dung obtained from an average cow. Most of the cattle in Dhanawas is stallfed. Thus the dung collection efficiency was taken as 100%. Camels, goats and poultry were not included in this calculation.

The average number of cow equivalents was found to be increasing with the land holdings. Most of the households which did not own cattle belonged to the landless category. Table 3.2.3 shows family-wise distribution of number of cow equivalents.

Table 3.2.1: Distribution of different types of livestock among different household categories

Economic Category	Type of household	No. of hh	No. of hh owning cattle	Cows	Buff	Bull	Calves	Camel	Goat	Poultry	Av. No. of cow equivalents per family
Economically Well-off	Large farmers	25	24*	21	34	17	62	-	-	-	6.1
	Medium farmers	17	16	7	25	10	28	1	-	-	4.8
	Farmers with additional occupation	25	24	11	28	1	38	-	-	-	3.4
	Landless households in service/ self-employment	23	16	8	15	-	20	-	-	4000	2.0
Economically Weaker	Small/marginal farmers	25	23	11	26	8	30	-	-	-	3.4
	Farmers with additional occupation	4	4	1	4	-	5	1	-	-	2.8
	Landless households in service/ self-employment/ labour	25	22	11	19	-	32	1	5	175	2.6
Total		144	129	70	151	36	215	3	5	4175	3.6

hh = household
* One household did not respond.
Buff = Buffaloes, Bull = Bullocks

Table 3.2.2: Daily dung availability from different animals

Cow	: 10 kg	Calf	: 8 kg
Buffalo	: 15 kg	Poultry	: 60 gm
Bullock	: 15 kg		

Source: Ref [3].

Variation in livestock population

Experience in the village prior to the survey had shown that the number of cattle heads owned keep fluctuating. One of the important objectives of this survey was to examine the pattern of sale and purchase of livestock and the variation in cattle-population for each category of households.

Table 3.2.3: No. of families with the given number of cow equivalents

Category	Type of household	No. of Cow Equivalents							Total No. of hh
		0	<2	2-4	4-6	6-8	8-10	10-12	
Economically well-off	Large farmers	-	-	4	7	8	4	1	24
	Medium farmers	1	-	6	4	4	2	-	17
	Farmers with additional occupation	1	5	11	5	3	-	-	25
	Landless house-holds in service/ self-employment	7	4	10	2	-	-	-	23
Economically weaker	Small/marginal farmers	2	5	9	7	1	1	-	25
	Farmers with additional occupation	-	1	3	-	-	-	-	4
	Landless house-holds in service/ self-employment/ labour	3	9	9	2	2	-	-	25
Total		14	24	52	27	18	7	1	143

hh: household
* One household did not respond.
The intervals include the upper limit but not the lower limit.

To determine the pattern of variation in cattle-population within a year, questions had been included to find out sale and

purchase of the cattle at specific times of the year by a household. However, response showed that the trading of cattle was done throughout the year. During discussions with some of them, it was found that sale/purchase of livestock depended on the household's requirement, fodder availability and the market price. The trading was either done through personal contacts or the melas occasionally held at nearby places.

As there was no pattern in the trading of animals, it was not possible to determine the actual variation in cattle population of a family from a single survey. It was thus decided to collect data on cattle population of each household every two to three months. It had been earlier decided to collect the data once a month starting from July 1987 but it was found that the villagers did not like to be questioned too frequently. The data which was collected by a village girl included the number of different animals currently owned by the household and the animals sold or purchased by the household since the time of last data collection and the reasons for the sale, if any, were also asked.

It was found that many households did not report sale or purchase of animals where as the actual population of different animals showed variation from the previous data. Sometimes an animal was reported to be sold in one month whereas animal population data showed that the same had been done prior to the previous data collection. Thus the responses of the households to questions on sale and purchase of livestock were not very reliable. Any increase in the number of calves was considered to be due to the birth of a new one. If there was a decrease in the

number of calves and simultaneous increase in the number of the corresponding adults, it was assumed that some of the animals reported as calves in the previous month had now been reported as adults.

This method of data collection and analysis has its limitations since it did not take into account the death of an animal. It also considered any possible purchase of a calf (if not reported by the household) as the birth of a calf. Any simultaneous sale of a calf and purchase of the corresponding adult was also not counted in the sale and purchase. However, there were not many instances of this kind and thus the error involved could be ignored. For an accurate data questions on birth and death of animals should also be included. For greater reliability of the responses on sale and purchase the previous data should be referred. The household should be asked to explain the change in animal population.

Reasons for sale of cattle could not be ascertained from this data. Most of the households, who reported sale of animals did not give any reason for it. Only in a few cases shortage of fodder was given as the reason for selling an animal.

Tables 3.2.4 and 3.2.5 summarize the results of this series of data on livestock population collected till June 1988. (The results of earlier survey are also included in 3.2.4 for comparison.)

Table 3.2.4 shows a steady decline in the total cattle population of the village. From March '87 to June '88 there was a 12% decrease in the total number of cattle. However, the population of different animals (particularly bullocks) shows

variation on both positive and negative sides. From March '87 to July '87, there is an increase in the number of bullocks, which could be attributed to the cultivation period of kharif. The number declined again in December 1987 after the ploughing for rabi crop. By February 1988 when ploughing operations were completely over, the figure came down drastically. As can be seen in Table 3.2.5, between August '87 and February '88 as many as 30 bullocks were sold and only one bullock was bought. As expected, the number of bullocks went up again in April and June '88 i.e. during the ploughing period for kharif. However, it can be seen that while in July '87 there were 45 bullocks in the village, in June '88 there were only 26. This indicates a shift towards mechanization.

Data analysis with respect to economic categories (Table 3.2.4) shows that between March '87 and June '88 there was a 35% decrease in bullocks owned by large farmers and 50% decrease in case of medium farmers whereas the number of bullocks remained same for small and marginal farmers. The large farmers were also found to be selling off their bullocks through out the year showing a steady shift towards mechanization while other categories of farmers sold them depending on the agriculture season. The population of cows shows a significant decrease from March to July '87 probably due to the drought period of 1987. A significant number of cows were sold during this period and very few were bought. However to conclusively find out whether this was typical of this season, data for more than a year is needed.

Table 3.2.4: Variation in no. of animals in the village between March'87 and June' 88.

Animal	No. in May 84	March 87	July 87	Aug 87	Dec. 87	Feb. 88	April 88	June 88
Cows	89	70	54	55	51	48	54	50
Buffaloes	151	148	133	130	123	119	119	124
Bullocks	57	36	45	45	32	16	21	26
Cow Calves	71							
Male		19	30	20	25	17	25	28
Female		50	46	52	40	61	54	43
Buffalo Calves	68							
Male		20	29	27	38	44	34	28
Female		132	125	132	142	138	126	117
Camels	-	3	3	3	2	2	2	2
Goats	50	5	6	1	-	15	5	7
Poultry	1000	4175	4494	1172	1006	2003	1018	1003
Total Cattle	436	475	462	461	451	441	433	416

Table 3.2.5: Number of animals sold or bought during March '87 and June '88

Animal	March' 87- July' 87		July' 87- Aug' 87		Aug' 87- Dec' 87		Dec' 87- Feb' 88		Feb' 88- Apr' 88		April' 88- June' 88	
	S*	B*	S	B	S	B	S	B	S	B	S	B
Cows	23	7	5	6	13	9	9	6	5	11	11	7
Buffaloes	24	9	11	8	29	22	17	13	14	14	12	17
Bullocks	2	11	2	2	13	-	17	1	2	7	6	11
Cow Calves M	7	18	10	-	6	11	14	6	7	15	8	11
F	18	14	3	9	20	8	4	25	21	14	21	10
Buffalo Calves M	11	20	8	6	18	29	12	18	18	8	11	5
F	28	21	10	17	24	34	23	19	28	16	21	12

* S = Sold M = Male
B = Bought/Born F = Female

No pattern of sale and purchase was observed with respect to the economic categories. However, from March '87 to June '88, the decrease in number of cows was found to be highest (62%) for the economically well off category of landless households, while for other categories it varied from 0 to 38%.

Buffalo population also showed a marked decrease during March-July '87. It continued till February '88. Although the number of buffaloes increased marginally in case of large, marginal and small farmers, it has been steadily decreasing for economically well-off farmers with additional occupation. Instances of both sale and purchase of buffaloes was found to be high for large, marginal and small farmers. Consequently the total number of buffaloes showed less variation over a period. In other categories, instances of sale were found to be more than that of purchase.

Table 3.2.6 Periodical variation in the total cattle owned by economic categories

Economic Category	Type of household	March '87	July '87	Aug '87	Dec. '87	Feb. '88	April '88	June '88
Economically Well-off	Large farmers	133	132	136	136	133	133	124
	Medium farmers	70	66	68	63	59	56	52
	Farmers with additional occupation	78	71	67	66	62	60	59
	Landless house-holds in service/ self-employment	44	38	36	33	32	30	29
Economically Weaker	Small/marginal farmers	79	93	93	89	90	88	85
	Farmers with additional occupation	10	9	8	11	11	12	11
	Landless house-holds in service/ self-employment/ labour	61	53	53	53	54	54	56
Total		475	462	461	451	441	433	416

Data indicates a high fluctuation in the number of goats and poultry in the village. Goats, which were found to be owned by some of the economically weaker households, were sold and bought quite frequently. Informal discussions revealed that goat rearing was subject to availability of a person in the household who could take them out for grazing.

Farmers who had additional occupation and the landless households show a steady decline in the cattle owned. For medium farmers also, the number declines after August '87. However in the economically weaker sections there is a fluctuation in the cattle owned. Variation is the least for the landless households in this category.

Table 3.2.7 gives the total number of cattle bought or sold by all the households in a given category during March '87-June '88. This throws a light on the extent of trading of animals in the village. Large farmers who owned the highest number of cattle also accounted for the highest number of purchases and sales. For most of the categories the extent of sale and purchase had a relation with the total number of cattle owned by them. However small and marginal farmers who owned about 16% of the cattle accounted for 26% of the purchases and 18% of the sales during the given period.

Table 3.2.7: Extent of sale, purchase of cattle by different economic categories

Economic Category	Type of household	Cattle Owned In March 87		Purchase of Adult Cattle March '87-June '88		Sale of Cattle March'87-June'88	
		No.	Percent of total cattle	No.	Percent of total cattle	No.	Percent of total cattle
Economically Well-off	Large farmers	133	28	43	27	136	24
	Medium farmers	70	15	18	11	85	15
	Farmers with additional occupation	78	16	18	11	93	16
	Landless house-holds in service/ self-employment	44	9	10	6	56	10
Economically Weaker	Small/marginal farmers	79	17	41	26	104	18
	Farmers with additional occupation	10	2	4	3	14	3
	Landless house-holds in service/ self-employment/ labour	61	13	24	15	78	14
Total		475	100	158	100	566	100

Dung Availability

Besides livestock population, it was also important to assess the dung availability from the animals for feasibility of biogas plant. One of the important factors affecting this is the location of these animals, i.e. in fields or at home. If all the animals are not usually kept at one place, the net dung availability for a biogas plant would be less. In case of bullocks the animals are partly kept in the field and partly at home during ploughing season. The questions were framed

considering these possibilities. However during the actual survey, such a format was not found to be very useful since in most of the cases, all the animals were kept at home through out the year. 18 households staying in the fields were keeping their cattle there all the time. Only five households reported taking all the cattle to the fields in rainy season. Out of these three were doing so in summer as well. Four households owning bullocks were keeping them in fields only during the rainy season. Only two households reported keeping bullocks in fields throughout the year while rest of the cattle was kept at home.

The other important factor in dung collection is the cattle feeding practices. Dung available from grazed cattle would be considerably less than that obtained from stallfed cattle. It was seen that in Dhanawas most of the cattle was stallfed. Thus during the survey, no direct questions were asked regarding the cattle feeding practices. However, in response to the questions sheltering of the animals, some households had reported taking them to the fields in the rainy and summer seasons. Observations after the survey and discussions with the villagers also showed that in rainy season and after harvesting, some of the households took the cattle out for grazing in common lands or to their own fields. Even some landless labourers took cattle for grazing even in other seasons. However, exact percentage of households who took cattle out could not be ascertained. Even those households who reported that their cattle was at home or in fields throughout the year might be leaving their cattle for grazing for some time during the year. For a better understanding of seasonal variation in cattle-feeding practices, suitable questions need to be incorporated.

3.2.2 Cooking Fuels

It was established from the first level survey that domestic sector is the major energy consuming sector in the village with collecting and/or preparation of fuel for cooking as one of the major activities of the village women. Hence, for a better understanding of the consumption pattern of various fuels, in the AIUN survey following data was obtained:

1) Various fuels used by the households in different seasons.
2) Their modes of availability.
3) Problems faced in different seasons, if any.

Information sought was only qualitative in nature. No attempt was made to get any quantitative data as that data was already available in the earlier report and the main emphasis here was on the nature of fuels were used in different seasons by different categories of households and if the households perceived shortage of fuel in any season.

In this section each kitchen was considered as a household. Thus 149 households were identified. As one large farmer did not respond, information was available for 148 families.

The information obtained on the use of different fuels is as follows:

1) Dungcakes

Dungcake was found to be one of the major cooking fuels used in Dhanawas. It was mainly used in Hara - the mud chulha primarily used for simmering milk and also for preparing cattle feed and heating water. Dungcakes were made by mixing crop residues like

hard part of wheat straw with cattle dung. If no crop residue was available, only dung was made into cakes. Though dung was available throughout the year, dungcakes were made only in summer and winter. In rainy season dung was put into the manure pit. In the month of June also dungcakes were not made. This was because a particular insect spoils the bottom surface of the cake while being dried on mud floor. This problem did not arise when the cakes were dried on cement floor. For use throughout the year dungcakes were stored in a mud-structure called the bitola.

Most of the households used the dung from their own cattle, and those who did not own cattleheads either collected dung from roadside or fields or purchased dungcakes from other households.

All the categories of households were found to be using dungcakes in all the three seasons. All the large farmers for whom data was collected were found to be using dung cakes in summer and winter, so was the case with economically well-off farmers with additional occupation. In rainy season there was a marginal decline in the number of families using dungcakes. The households not using dungcakes in either season mainly belonged to the landless class (both economically well-off and economically weaker).

2) Mustard Stalk

Mustard being one of the major rabi crops, its contribution to domestic energy sector was found to be quite high. Mustard stalk was the only crop residue used by most of the households for a large part of the year. As mustard stalks burn at a higher rate than the dungcakes they were primarily used for making rotis in the mud chulha.

The landless households and those who did not cultivate mustard got the residue in exchange for labour. It was a prevalent practice in the village that the person who harvested the crop was allowed to take that part of mustard stalks which was harvested by him or her.

Mustard stalk was mainly available in the summer after harvesting of mustard in March-April. Large farmers were found using mustard stalk in summer and rainy seasons. Among the landless class, a significant percentage of people were not using mustard stalk. In the economically backward landless category, as many as 50% of the households did not have access to mustard stalk.

The picture remained more or less the same in the rainy season too. A few households in the service class reported use of mustard stalk in rainy season but not in summer. Apparently it was done to save the stalk for rainy season.

As the stock of mustard stalk started depleting by winter, the number of households using this residue was found to be less in this season. However, most of the farmers' families were found to be having stock even in winter. Among the landless class, only about 30% families had some stock till winter.

The landless households had a constraint of storage space too. As they had to get the stalk home immediately after harvesting, they could store only limited amounts. Farmers, on the other hand, normally stacked the stalk in their fields and got it home periodically and thus could store more stalk.

3) Guar Stalk

Guar is a kharif crop and its residue is available for use in winter. Due to less area under cultivation in kharif season, in Dhanawas guar stalks were not available in very large quantities. Most of the households used it as a fuel though a few large farmers left the stalks in the fields. As fuel, guar stalks mainly served as a substitute for mustard stalks in winter. In all only 27% of the families in the village were found to be using this fuel. In the economically weaker landless category only 15% households reported use of guar.

4) Other Crop Residues

Two households reported the use of bajra stalks as fuel in winter. Chana stalk was also found to be used by one household. Both bajra and chana are kharif crops and their stalks are generally used for fodder.

5) Wood

This includes commercial fuelwood as well as non commercial wood i.e. twigs etc. Twigs were collected by women either from trees in the fields, or from those on the roadside or nearby plantations. Some of the households also bought commercially available fuelwood from Faroukhnagar, the nearest town at a distance of 7 km from the village. In the large farmer category, highest percentage of families reported use of wood in summer and winter. Economically well-off farmers with additional occupation were found to be using wood the least. In all 12 families were buying fuelwood, many of whom were landless.

6) Kerosene

Kerosene was also bought from Faroukhnagar at the controlled rate. A large number of the families using kerosene belonged to the economically well-off categories of landless households and farmers with additional occupation. These families reported using it in all the seasons.

7) LPG

At the time of survey, 3 households were using LPG. The LPG cylinders had to be brought from Gurgaon. All the households were in the economically well-off category. Two of them were large farmers and one belonged to the landless class.

8) Biogas

Three households had biogas plants at the time of survey. Two of them were large farmers and one a medium farmer. It was found that biogas was mainly being used for tea, fodder preparation, cooking vegetables etc. For rotis, the conventional mud-stove was being used. For slow-heating of milk the Hara was used.

Seasonal use of fuels

Tables 3.2.8, 3.2.9 and 3.2.11 give the number of families using different fuels in different seasons. As can be clearly seen, in summer, apart from dungcakes mustard stalk was the main fuel. Wood was also quite widely used as it is easy to get dry twigs in this season.

Table 3.2.8: Number of families using various fuels in summer

Fuel	No. of hh using the fuel				Total No. of hh using the fuel	Percentage of hh using the fuel
	Own	Bought	Exchange for labour	Collected		
Dungcakes	133	11	-	6	138	96.5
Mustard stalk	90	-	32	-	121	84.6
Wood	35	10	-	-	87	60.9
Guar	-	-	-	-	-	-
Bazra stalk	-	-	-	-	30	-
Kerosene	-	30	-	-	3	21.0
LPG	-	3	-	-	3	2.1
Electricity	-	3	-	-	3	2.1
Biogas	3	-	-	-	3	2.1

hh = household

In rainy season too, dung cakes and mustard stalk were the main fuels in use. Use of wood declined in this season due to non availability of dry twigs. Many of the households using twigs from their own trees already had it stored in their house while majority of the landless people collected it from roadside trees or from those on community lands. The number of households reporting use of other commercial fuels i.e. kerosene and electricity also did not increase in rainy season. Thus there was no change in the nature of fuels being used.

Table 3.2.9: Number of families using various fuels in rainy seasons

Fuel	No. of hh using the fuel				Total No. of hh using	Percentage of hh using the fuel
	Own	Bought	Exchange for labour	Collected		
Dungcakes	127	11	-	6	132	92.3
Mustard stalk	91	-	32	-	122	85.3
Wood	33	11	-	20	59	41.3
Guar	-	-	-	-	-	-
Bazra stalk	-	-	-	-	-	-
Kerosene	-	30	-	-	30	21.0
LPG	-	3	-	-	3	2.1
Electricity	-	3	-	-	3	2.1
Biogas	3	-	-	-	3	2.1

By winter season, there was a depletion in stocks of mustard stalk and hence there was a decrease in the number of families using mustard stalk although it was insignificant.

Table 3.2.10: Number of families using various fuels in winter

Fuel	No. of hh using the fuel				Total No. of hh using the fuel	Percentage of hh using the fuel
	Own	Bought	Exchange for labour	Collected		
Dungcakes	34	11	-	6	139	97.2
Mustard Stalk	73	-	20	-	92	64.3
Wood	37	11	-	31	74	51.8
Guar	30	-	9	-	38	26.6
Bazra Stalk	2	-	-	-	2	1.4
Kerosene	-	30	-	-	30	21.0
LPG	-	3	-	-	3	2.1
Electricity	-	3	-	-	3	2.1
Biogas	3	-	-	-	3	2.1

hh = household

Problems in meeting fuel needs

To identify the possible scarcity of cooking fuel in the village, each household was asked about the problems faced in getting

cooking fuel in any particular seasons. No attempt was, however made to quantify the shortage of fuel.

Table 3.2.11 gives the number of families in different categories who perceived a fuel problem in a particular season. It can be seen that 49 households (33%) faced shortage of fuel in one or more seasons, majority of whom belonged to the landless category, both economically well-off and economically weaker sections. In the category of economically well-off, farmers with additional occupation and small and marginal farmers also, considerable number of families reported facing a problem.

Problem of fuel in summer was very little for all categories due to availability of mustard stalk and dry twigs in abundance. The main difficulty was faced in rainy and winter seasons. In rainy season, storage of fuels was a big problem. In addition no twigs could be obtained from the trees or common lands.

Problem in winter due to shortage of crop residues, (mustard stalk) was mainly faced by landless people and marginal farmers. Problem was particularly acute for those families in labour class who did not own cattle and thus neither had enough dungcakes nor could buy commercial fuels. Landless villagers, who had a reasonably good income from service or business mainly managed their requirements with kerosene or commercial fuelwood.

Table 3.2.11: Number of families facing fuel problem in different seasons

Economic Category	Type of hh	Total No. of hh	No. of families facing problem			No. of families facing no problem		
			Summer	Rainy	Winter	Summer	Rainy	Winter
Economically Well-Off	Large	28*	-	2	3	27	25	24
	Medium	18	-	2	3	18	16	15
	Farmers with additional occupation	25	2	13	11	23	12	14
	Landless house-holds in service/ self-employment	23	3	11	9	20	12	14
Economically Weaker Sections	Small/marginal	26	1	7	8	25	19	18
	Farmers with additional occupation	4	1	3	3	3	1	1
	Landless house-holds in service/ self-employment/ labour	25	5	13	11	20	12	14
Total		149	12	51	48	136	87	100

Note: Information about one household in large farmers' category was not available.
hh = household

On the other hand, it was seen that as many as 71% households constituting mainly of large and medium farmers did not perceive any fuel problem throughout the year. Families in other categories using kerosene and fuelwood also did not not face any problem.

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3.2.3 Agricultural Practices

Agriculture being the main source of income in the village, it was considered desirable to determine if improvements could be made in the current practices of energy use by way of better technologies and a more judicial use of resources. To make necessary changes, the land utilization pattern had to be understood better. Some information on the extent of land utilized in different cropping seasons and the crops grown was available from the first level surveys but in this survey, attempt was made to have a deeper understanding of how each farmer used a particular piece of land.

Categorization of households

As pointed out in Section 3.1, to make the different groups of households more representative of their economic status, certain deviations were made from the standard classification norms. For the data related to agriculture, classification was made only on the basis of land. As earlier, cultivable land owned or land under self-cultivation, whichever was greater was considered for classification under different farmer categories. At the time of survey 96 households were found to be practicing agriculture out of which 93 were land owners and 3 were landless farmers cultivating land taken on lease. Table 3.2.12 shows the number of households under each category of farmers.

Table 3.2.12: Categorization of households according to cultivable land owned/under cultivation

Category	Land owned/ under cultivation (acre)	No. of hh	Percentage of hh	Land under cultivation (acre)
Large	>10	25	26	452.3
Medium	5-10	19	20	134.0
Small	2.5-5	25	26	92.0
Marginal	0-2.5	27	28	41.1
Total		96	100	719.4

Note: The intervals include the upper limit but not the lower limit.
hh: household

Land utilization

In Dhanawas, there are only two main cropping seasons. At the time of survey, wheat, barley mustard and gram were the major crops in rabi, whereas in kharif mainly fodder crops like jwar, bajra and guar were grown. Groundnut was also cultivated by few farmers as a kharif crop. Some other minor crops (like kaitha) are also grown for fodder between rabi and kharif. However, information about them was not available.

The cultivable land in village Dhanawas was 682 acres. Land was given and taken on lease by farmers both within the village and outside the village. Due to fresh transactions, the total land under cultivation changed every year. At the time of survey, 719.4 acres of land was found to be under cultivation by Dhanawas farmers. This includes land leased from neighbouring villages also.

Rabi, being the main cropping season, maximum land (85%) was utilized in this season. In kharif much smaller area (42%) was under cultivation. Table 3.2.13 and 3.2.14 give the land utilized by various categories of farmers in the two seasons. Table 3.2.15 gives the corresponding figures for land cultivated and the cropping intensity for different farmers' categories. It can be seen that in rabi more than 60% farmers utilized their land fully whereas in kharif only 15% of the farmers cultivated the land fully. Most of them belonged to the small and marginal farmers' category, 30% of the marginal farmers and 16% of the small farmers were cultivated both rabi as well as kharif. The cropping intensity, which indicates the extent of land utilized in the whole year was also found to be the highest for marginal farmers and the lowest for large farmers.

Table 3.2.13: Number of farmers cultivating land in rabi and kharif in 1986-87

Farmers' Category	Total no. of families	Rabi No. of farmers using land		Kharif No. of farmers using land		No. of farmers cultivating land only in Rabi	No. of farmers cultivating land fully in both Rabi and Kharif
		Fully	Partially	Fully	Partially		
Large	25*	11 (land)	13 (land)	-	23	1	-
Medium	19	11 (land)	7 (land)	1	17	-	-
Small	25	15	7	4	14	5	4
Marginal	27	23	-	10	6	6	8
Total	96	60	27	15	59	12	12

* Information for one hh is not available.

Table 3.2.14: Land utilization in rabi and kharif in 1986-87

Farmers' Category	Total Cultivable Land	Land under cultivation				Cropping Intensity
		Rabi		Kharif		
	(acre) (a)	acre (b)	% of cultivable land	acre (c)	% of cultivable land	(b + c)/a
Large	452.3	370.5	81.9	182.0	40.2	1.22
Medium	134.0	121.8	90.9	57.0	42.5	1.33
Small	92.0	82.0	89.1	41.0	44.6	1.34
Marginal	41.1	37.1	90.2	24.6	60.0	1.50
Total	719.4	611.4	85.0	304.6	42.3	1.27

Land under cultivation for various crops was not same for all the years. Informal discussions with farmers after the survey showed that in Rabi season, decision to put greater area under wheat or mustard largely depended on the weather conditions. As mustard could survive drought conditions better than wheat, it was preferred in case of less rainfall. Mustard requires less investment and has high returns but it is more prone to diseases and hence involves a greater risk. Thus wheat was preferred when good irrigation could be ensured. A significant percentage of the area was also covered under barley since it needs less moisture. Cultivation of land in kharif also had a bearing on crop to be sown in rabi. As harvesting of kharif and sowing of mustard, both are done in October, the area to be put under mustard was generally left fallow in kharif. Fallow land was also ploughed a number of times much before sowing for rabi. Ploughing and sowing of wheat was done after harvesting of kharif crop.

Rotational and mixed cropping were also found to be quite commonly practiced. During the survey a number of farmers gave the total area under wheat and barley or under wheat, barley and mustard without giving the break-up. However, discussions after the survey showed that mixed cropping in rabi was mainly done between wheat and mustard or barley and mustard. Wheat and barley are mixed only in a few cases. As the two crops are similar in appearance, this is done only when the farmer decides to harvest both of them together. Thus the combined area under two or more crops may refer to either mixed cropping or total area under these crops. Tables 3.2.16 gives the area under various crops for rabi and kharif with reference to different categories of farmers for the year 1986-87.

Table 3.2.15: Area under various rabi crops for the different farmer categories in 1986-87

Crop	Area Under the Crop in Acres					Percentage of total cultivable land
	Large	Medium	Small	Marginal	Total	
Wheat	138.0	46.5	40.5	26.8	251.8	41
Barley	70.0	10.5	6.0	3.8	90.3	15
Mustard	70.0	27.0	6.0	1.0	104.0	17
Gram	23.0	6.8	5.0	-	34.8	6
Wheat + Barley	23.0	12.5	2.0	2	39.5	7
Wheat + Barley + Mustard	30.0	-	21.5	2.5	54.0	9
Others	16.5	18.5	1.0	1.0	37.0	6
Total	370.5	121.8	82.0	37.1	611.4	

It can be seen that small and marginal farmers cultivated most of the area with wheat. In kharif, jwar covered greater area than guar and bajra. Guar being cultivated by the large farmers.

Some farmers also grew fodder crops like jwar and bajra soon after harvesting of rabi in April. This intermittent crop was, at times harvested more than once. This was not reported in the survey although visits to the village showed a significant part of the cultivated land even between April and July.

Table 3.2.16: Area under various kharif crops for the different farmer categories in 1986-87

Crop	Area Under the Crop in Acres					Percentage of total cultivable land
	Large	Medium	Small	Marginal	Total	
Jwar	66.5	14.0	14.0	10.5	105.0	34.5
Bajra	10.0	5.5	2.0	2.0	19.5	6.4
Guar	50.0	14.5	6.0	1.0	71.5	23.5
Groundnut	4.0	-	2.0		6.0	1.9
Jwar and Bajra	25.0	13.5	15.0	11.2	64.7	21.2
Jwar and Bajra-Guar	9.0	3.0	-	-	12.0	4.0
Others	17.5	6.5	1.0	-	25.0	8.5
Total	182.0	57.0	40.0	24.7	303.7	100.0

Fertilizer usage

Quantitative information on the use of fertilizer by different categories of farmers and for various crops could not be obtained. Some farmers could not give the amount of fertilizer

used for different crops as few did not use any fertilizer while others of them did not have any idea. However, it was generally seen that both composted manure and inorganic fertilizers were widely used. Farm yard manure was utilized alternatively for rabi and kharif crops. Large and medium farmers with relatively large cattle heads were able to use farm yard manure for both the crops but due to insufficient availability, it was applied rotationally to different parts of the land. The commercial fertilizers were mainly used for rabi crops. Fertilizers like Urea and DAP were widely used while Zinc phosphate, Potash and Superphosphate were used in very low quantities. 2-3 trolleys (equivalent to 5-6 tons) of organic manure was considered to be sufficient for one acre. Composted manure was spread in the fields before ploughing while commercial fertilizers were used at various stages of crop growth.

Irrigation requirements

In Dhanawas, underground water is the only source of irrigation. Hence both electric and diesel pumpsets were found to be used for this purpose. Detailed information on pumpsets is given in Section 3.3.At the time of the survey there were 90 pumpsets and 3 persian wheels in the village. It was found that those who did not own a pumpset were purchasing water at the rate of Rs.50/- per acre per irrigation. Table 3.2.19 shows the irrigation requirements of various crops.

Table 3.2.17: Irrigation requirements for various crops

Crop	Months	No. of times
Wheat	Nov-March	6-7 times with 15 days intervals.
Barley	Nov-Feb	3-4 times with one month interval.
Mustard	Nov-Dec	2 times with one month interval.
Gram	Nov-Feb	2 times, once in Nov and once in Feb.

3.2.4 Agricultural Residues

Agricultural biomass plays an important role in various needs of the villagers. Prior to dissemination of any technology using this biomass, it was essential to understand the present pattern of utilization of residues obtained from different crops.

Following are the main residues obtained from the crops in Dhanawas and their uses:

Wheat straw

Wheat straw is the main residue from wheat and is obtained after threshing in threshing machine. It is stored inside the house and used as fodder for the cattle (known as "Bhusa" locally).

Barley straw

Generally both wheat and barley straw are mixed together for fodder.

Mustard stalk

Mustard is harvested by cutting the head i.e. grain parts of the plant. The lower part i.e. the stalk is the main residue

obtained and is one of the most widely used cooking fuels (locally known as Dankla).

Juar stalk

This residue is also used for fodder.

Bajra stalk and bajra cob

Bajra stalk is the residue obtained after harvesting. The cob obtained after threshing is in a very fine form and is either left in the fields or used as fodder.

Guar stalk

Guar is a leguminous crop, the seed of which is used as fodder. The stalks after removing pods are either used as fuel or left in the fields.

Groundnut, Moth, Tai and Kaitha are some other minor crops used as fodder.

Quantitative estimates of residues

It was intended to estimate the quantity of biomass available from different crops by just questioning the farmers. However, in practice various problems were experienced.

1) No standard measure was found to exist for the crop residue. Information obtained from the farmers was in terms of local measures such as tractor loads and cart loads and munds (each mund is 40 kg). Conversion factors of common agreement could not be obtained for these local measures (Finally, the values quoted by relatively more number of farmers were used).

2) For most of the crop residues, farmers were not aware of the actual quantity obtained. At times data was given in terms of approximate grain to residue ratio but they were not sure whether it was weight or volume.

3) In case of mustard in particular, it was very difficult to estimate the quantity available. Since the stalk was used for local consumption, it was generally stacked in the fields and brought home as per convenience and was not weighed. A part of the crop residue was also given to the labour as wage for harvesting. It was difficult to estimate the part given away. Thus it was not possible to arrive at the figure of total availability of the residue for a household.

4) Some residues were left in the fields as fertilizers. No quantitative measures were available for them.

5) The quantity of residue was also reported to vary with varying seed varieties.

As percentage of data available in case of residue was quite low, it was considered desirable to estimate residue availability using the grain yield quoted by the farmers and the standard grain to residue ratios. However, the information available was in terms of yield/acre and thus for finding the total yield area under that crop were to be known. In the questionnaire, the area had been determined in the section on agricultural practices as well as in the section on agricultural residues. At the time of data analysis, in some cases, the areas quoted at the two places were found to be different. Finally, the area quoted in the agricultural section was used. There was also a problem in finding the area under each crop for mixed

cropping. In such cases only one of the crops was considered. Thus from whatever data was available, the average grain yield was calculated. Table 3.2.20 lists this average with the standard deviation of the data which indicates a large variation. The mean of the data has also been compared with the standard grain yield figures available for Haryana region. The table also compares the available data for the crop residue with the standard figure.

Table 3.2.18: Comparison of average yield of grain and residues from survey with the standard data

Crop		Percentage of households giving information	Survey data		Standard* yield for Haryana (kg/acre)	Percentage deviation from standard data
			Average Yield (kg/acre)	Percentage standard deviation		
Rabi						
Wheat	G	88	1044	32	1026	+ 1.7
	R	81	1568	21	1540	+ 1.8
Barley	G	53	821	46	620	+ 32.4
	R	40	954	32	980	- 2.7
Mustard	G	89	309	22	284	+ 8.8
	R	42	381	54	1008	- 62.2
Gram	G	86	443	43	226	+ 96.0
	R	50	424	40	452	- 4.3
Kharif						
Jwar	G	17	657	70	54	- 1115.9
	R	66	588	58	216	+ 177.0
Bajra	G	77	445	113	267	+ 66.5
	R	75	515	61	443	+ 16.2
Guar	G	11	424	44	260	+ 63.0
	R	-	-	-	520	-
Groundnut	G	100	429	7	286	+ 49.9
	R	100	100	82	400	- 75.0

G: Grain R: Residue

* The grain yield for Haryana has been taken from Ref [4] and the residue yield has been calculated using this grain yield and grain to residue ratio from Ref [5].

In case of grain yield, it can be seen that except for groundnut, which was being grown by very few people, the standard deviation of the data varied from 22% to 113%. The variation in the data of grain was less for mustard and wheat but it was quite high for kharif crops. Deviation of the average from the standard figures was also not very high for mustard and wheat. This could be because the grain of these crops is sold in the market and hence more accurately weighed where as kharif crops are mainly for fodder. Many a times the produce from them is not weighed at all. As they are not threshed, the farmer does not always have an idea of the quantity of the produce (generally the volume of the grain is determined at the time of threshing). For jwar and guar, most of the households could not give the information on the grain yield. Whatever information was available from jwar was also found to be totally different from the standard figures. For barley, gram and all kharif crops, deviation from the standard was quite high.

In case of residue, percentage of information available was much less. The standard deviation of the data was lowest (21%) for wheat while for all other crops it ranged from 32% to 82%. The average yield of the residue/acre was also very close to the standard figures. The deviation from the standard was very high for mustard stalk which clearly shows that the farmers did not have much idea about the amount of mustard stalk available.

Among the kharif crops, no information was available about residue of guar which is mainly used as a fodder. The data on jwar stalk was also very different from the standard figures.

In view of the variation in the data of grain yield as well as residue, finally an estimate of the availability of residues in Dhanawas was made by using the area under each crop in the village and the standard values of grain yield/acre and the grain to residue ratio. Table 3.2.21 gives this estimate for the main crops of Dhanawas.

This data gives a picture of only the supply side of biomass. To determine whether there was any surplus of biomass in Dhanawas, the data on the consumption side is also required.

In case of residues used as fuel, it was observed that a number of households faced shortage of residue in winter, though some households (most of them large and medium farmers) had enough mustard stalk (the main crop residue used as fuel) throughout the year. However, to find out if any individual households have a surplus, data on the consumption pattern should be collected for the households using mustard stalk throughout the year.

Table 3.2.19: Availability of agricultural residues (1986-87)

	Crop name	Area under the crop (acre) (1)	Standard Values of grain yield for Haryana (kg/acre) (2)	Standard Values of residue per unit value of grain (3)	Residue Yield (kg/acre) (2)/(3)	Total Residue (ton) (1)X(2)/(
Rabi	Wheat	329.38	1026	1:1.5	1540	507
	Barley	108.8	620	1:1.58	980	107
	Mustard	132.5	284	1:3.55	1008	133
	Gram	40.8	226	1:2	452	18
Kharif	Jwar	120.45	54	1:4	216	26
	Bajra	90.2	267	1:1.66	443	40
	Guar	79.0	260	1:2	520	41
	Groundnut	7.0	286	1:4	1144	8

Source: Ref [4] and [5]

3.3 Potential for Energy Development Activities

The section provides information collected on cookstoves, biogas, pumpsets and biomass development activities.

3.3.1 Cookstoves

TERI, as stated earlier, had taken up dissemination of two kinds of cookstoves (chulhas):

1) Portable metal chulha - TARA
2) Mud chulha with chimney - Nada

In this survey information relevant to their dissemination was obtained for both the chulhas.

a) TARA chulha

It was intended to find out, through the survey, the scope of utilization of the chulha and the level of satisfaction among users. Besides this, the villagers who hadn't taken the chulha were also asked the reasons and if they would consider to buy it later. This was to help in assessment of potential of its further dissemination and to identify the possible constraints.

The survey showed that 96 TARA chulhas sold in the village had gone to 56 households. It was found that a large number of households had taken chulhas for their relatives outside the village. However, it was not possible to find out the number of chulhas purchased by each house as some of the households were found to be giving incorrect figures. Table 3.3.1 gives the distribution of chulhas as per the economic categories of the households. It can be seen that 40% of the households from the economically well-off category had bought the chulha, whereas corresponding figure for the economically weaker households was 33%.

During the survey, a significant number of households in both the categories showed willingness to buy the chulha. A few households could not buy it due to monetary problems. About 28% of the households were not willing to have the chulha at all. While 5 of these did not feel the need as they were using LPG or kerosene stoves, some others did not want to have it either because of its small size or other drawbacks as enumerated later. Most of the large farmers were seen to be reluctant to have it. In most of the other cases, where no concrete reasons were given, investigators felt that there was a general resistance to experiment on new device. Women in 14 households left the decision of having the chulha on the male members of the family. Seven households were found to be unaware of the chulha as they were staying in the fields. Only three of them showed interest in buying it.

Table 3.3.1: Distribution of households having TARA chulha

Economic Category	Type of hh	Total no. of hh	No. of households			
			having TARA	willing to have it	unwilling to have it	where women were unsure
Economically Well-off	Large farmers	28	10	6	13	1
	Medium farmers	18	6	5	3	2
	Farmers with other occupations also	25	9	6	9	1
	Landless Hh in service/ business/ artisans	23	13	3	6	1
Economically Weaker	Small/Marginal Farmers	26	10	7	5	4
	Farmers with other occupation	4	2	-	1	1
	Landless	25	6	9	4	4
Total		149	56	36	41	14

Response of the users

It was found that out of 56 households who had bought the chulha, four had given it to their relatives and three were not using it as they did not like it. Four households used it only in rainy season.

The response of the others, who were using the chulha, was found to be mixed. While most of them felt it saved fuel as well as time and were satisfied on that account, they also identified some of its drawbacks. The most important of these, as can be seen in Table 3.3.2 was its unsuitability for making rotis in the

traditional way. (The chulha has a small firebox and thus rotis cannot be baked inside the box as is done in the conventional chulhas.) Other drawbacks included lack of a tray for ash collection because of which ash fell on the floor and heating up of the metal body. Some of them also felt, it was too small and could accommodate very less fuel at a time (this was most common reason quoted by unwilling non-user). But in spite of the drawbacks as many as 77% of the users expressed their satisfaction with the chulha.

But most of the households were using it only for making tea and cooking vegetables. Most of the work (which included making rotis) was still being done on the traditional chulha. Only one household reported making rotis too on the chulha by altering the method of baking rotis.

b) Nada chulha

Prior to the survey only 10 Nada chulhas had been installed in the village as a demonstration. In addition to the assessment for their potentiality and viability, it was also intended to find out if women in the village would be interested in getting trained in Nada chulha construction. These trained women could then construct the chulhas in the village and hence benefit economically.

Table 3.3.2: Response of users towards TARA chulha

Total number of hh using the chulha : 48

Number of hh generally satisfied with it : 37

Number of hh not satisfied with it : 9

Reasons for satisfaction	No. of hh	Reasons for dissatisfaction	No. of hh
1. Consumes less fuel	29	1. Cannot make rotis	11
2. Gives out less smoke	13	2. Too small	3
3. Takes less time	25	3. Gets too hot	4
		4. Ash spreading on the floor	3
		5. Blackens the vessels more	2
		6. Does not burn dungcakes well	1
		7. Twigs have to be made into pieces	
		8. Cannot make use of logs	

hh : household

The survey showed that out of ten chulhas installed, eight were in use. The users were satisfied with the chulha mainly because of smoke removal. They could not experience any reduction in fuel consumption in this chulha vis-a-vis the conventional chulha. It was also found that the women mostly preferred to cook outside in the open and thus the Nada chulha, which was built in-doors because of its chimney, could be used only in winter and rainy season.

The response of other households towards this chulha was quite favourable. Table 3.3.3 shows that 43 households, who had a kitchen, showed willingness to have the chulha, 13 of which belonged to economically weaker section. But a large number of them (as many as 54 households) which include 44% of economically

weaker section did not have a kitchen and hence could not get the chulha installed. Twenty three households were unwilling even though they had a kitchen. Out of a total of 149 households, 22 were found to be unaware of the chulha.

The information on potential of training in Nada chulha construction has been covered in Section 3.4.

Table 3.3.3: Distribution of households willing to have Nada chulha

Economic Category	Total no. of hh	No. of households			
		willing to have NADA	having kitchen	not having and not willing	not sure
Economically Well-off	Large	28	8	6	8	2
	Medium	18	2	5	6	3
	Farmers with other occupations	25	13	3	3	1
	Businessmen/ Artisans/In Service	23	7	4	13	1
Economically Weaker	Small	26	10	3	10	2
	Marginal	4	-	2	2	-
	With other occupation	25	3	-	12	6
	Landless	149	43	23	54	15

3.3.2 Biogas

Biogas programme had been initiated in the village with the construction of three family size fixed dome plants. Through the survey it was intended to assess the net potential for biogas technology in the village for further dissemination. Thus

information regarding the cattle population, space availability, financial capability and willingness to have biogas plants was collected.

Potential based on cattle-heads

Cattle population data of Dhanawas has been already presented in section 6.2. To get an idea of the gross potential for biogas generation for the village as a whole, total live-stock population including cattle and poultry were considered. Camels and goats were not taken into account. As shown in table 3.3.4, the biogas generation potential for the village was found to be 234 m^3 of gas/day.

Considering the total human population as equivalent to 665 adults and gas requirement for cooking as 340 l/person-day, the total gas requirement of the village comes to 226 m^3/day, which is within the gas generation capacity of the village.

Table 3.3.4: Gross potential for biogas generation in Dhanawas

Animal	Total Number	Dung Available* (kg/day)	Gas Available per kg of dung* (m^3)	Total Gas Generation Capacity (m^3/day)
Cows	70	10	0.04	28
Buffaloes	151	15	0.04	91
Bullocks	36	15	0.04	22
Calves	215	8	0.04	68
Hens	4175	0.06	0.1	25
Total				234

* Source: Ref. [3]

Although theoretically, biogas from dung can meet all the cooking requirements of the village if a community biogas plant is installed, this was not possible in reality since community approach for biogas promotion was not feasible. Hence the potential had to be exploited mainly through family size plants.

In such a case households having less number of cattle, could not have a biogas plant. It was seen that only 51 out of 130 households owning cattle, had enough cattleheads for an individual biogas plant (2 m^3/day). Table 3.3.5 gives the economic distribution of these households. It is seen that 76% of the households having potential for a biogas plant belonged to the economically well-off category. Most of the large farmers had enough cattle for a family size plant.

With biogas plants in these 51 households, 173 m^3 of gas would be generated per day, which constitutes 74% of the total village capacity of 234 m^3/day.

Table 3.3.5: Potential for biogas plants of different capacities

Economic Category		Total No. of hh	No. of hh having potential for a biogas plant				Total No. of hh having biogas potential
			2 m^3/day	3 m^3/day	4 m^3/day	25 m^3/day	
Economically Well-off	Large	25	9	6	3	-	18
	Medium	17	7	1	2	-	10
	Farmers with other occupations	25	6	2	-	-	8
	Businessmen/ Artisans/In Service	23	2	-	-	1	3
							-
Economically	Small/Marginal	25	6	2	-	-	8
	With other occupation	4	-	-	-	-	-
	Landless	25	2	2	-	-	4
Total		144	32	13	5	1	51

Constraints in technology promotion

Sufficient number of cattle heads is the primary requirement for a biogas plant but it was seen that apart from this, various other constraints could come in the way of promotion of the technology. Out of 51 households with enough cattle to have a plant only six were willing to have a plant immediately and five showed some interest for future. Rest of them expressed their unwillingness due to various reasons. Space constraint was found to be one of the main hindrances in installation of a biogas plant. It was a ruling factor particularly for the landless people who had limited space for a plant to be constructed.

economic constraints, easy and adequate supply of crop residue as fuel and initial resistance to adopt new technology are some of the other constraints quoted.

It was however felt that the households are not impressed by the fuel and fertilizer related advantages of the technology. The fluctuations in cattle population may also influence the adoption of this technology. In past, it was found that the performance of the plant was affected due to sale and purchase of cattle.

Table 3.3.6 : Potential for biogas technology

Category	No of hhs
1. Households having enough cattleheads and willing to have a plant	
i) Willing to have immediately	6
ii) Willing to have in near future	5
2. Households having enough cattleheads but not willing to have the plants due to	40
i) insufficient space for plant construction	19
ii) resistance to adopt new technology	5
iii) shortage of manpower	5
iv) not having enough money	5
v) not required as sufficient crop residue available for fuel	5
vi) having LPG	1
vii) reasons not specified	4
3. Households having insufficient cattleheads	76
4. Households not having any cattleheads	14
5. Households already having the plant	3

3.3.3 Pumpsets

Pumpsets were found to constitute the main portion of the water-lifting devices used by the farmers of Dhanawas for their agricultural lands though Persian wheels were also used at a few places.

While designing the questionnaire, it had been assumed that a person using a pumpset owned it too. However, it was later found that a number of pumpsets were shared by more than one family. As the ownership of the pumpset had not been identified during the survey, this led to repetitions in some cases. Apart from this, in two cases it was found that the household had two borewells and one diesel engine which was shifted as per the irrigation requirement. However, at the time of the survey, each household had reported use of two pumpsets. To avoid this problem, the ownership of the pumpset must be identified at the time of the survey.

Overall Scenario

It was found that 60 farmers (out of 96 farmers) owned 90 pumpsets. Out of these 63 were electrically operated and 27 were diesel operated. In addition, there were 3 Persian wheels, one among which was not in use. Table 3.3.6 gives the number of households owning pumpsets in each category of farmers. Most of the large and medium farmers were owning pumpsets. Majority of the large farmers owned both electric and diesel pumpsets, the latter being mainly kept as stand-by. In all other categories farmers either owned electric or diesel pumpsets, with a majority of electric ones. In the marginal farmers' category only 30% households were found to be owning pumpsets.

Table 3.3.7: Number of farmers in different categories owning pumpsets

	Total No. of Farmers	No. of Farmers owning Pumpsets			Total No. of farmers owning pumpsets
		Only Electric	Only Diesel	Both Electric & Diesel	
Large	25*	8	1	13	22
Medium	19	11	4	-	15
Small	25	13	2	-	15
Marginal	27	5	2	1	8
Total	96	37	9	14	60

* Information for one household was not available.

Electrical pumpsets, being easy to operate and having less capital as well as running cost as compared to the diesel operated pumpsets, were preferred by a large number of villagers. Seventy percent of the pumpsets in Dhanawas were found to be electrically operated, 89% of which were of monoblock type and the rest were of belt and pulley type.

The electric pumpsets were of 3 HP and 5 HP rating whereas the diesel pumpset rating ranged from 5 HP to 8 HP. 3 HP pumpsets constituted a majority of the electric pumpsets. Table 3.3.7 illustrates the number of pumpsets of various ratings in the village. It also lists the area in the command of each category of the pumpsets. One pumpset which is tractor operated has been treated as a diesel pumpset.

Table 3.3.8: Capacity of pumpsets and area under irrigation

Type of pumpset	Rating (HP)	No. of Pumpsets	Area under irrigation (acres)	Average area/HP
Electrically operated	3	47	309	2.19
	5	16	172	2.14
Total		63	481	

Electrical pumpsets covered 481 acres of land where as diesel pumpsets were irrigating only 184 acres. The average land irrigated per hp is 2.19 acres for 3 hp electric pumpsets and 2.14 acres for 5 hp electric pumpsets. These figures could not be calculated for diesel pumpsets because they were mostly used as stand-by. Diesel for these pumpsets was brought either from Gurgaon or from Faroukhnagar. It was found that two households were irrigating their lands with water purchased from their neighbours.

A frequency distribution based on the year of installation of the pumpsets (Table 3.3.9) shows that there was a spate of electric pumpset installations in Dhanawas between 1970 and 1974. A sharp decrease, was however observed after 1984. Interestingly, the number of purchases of diesel pumpsets were found to have gone up after 1980. Before 1980, there were only four diesel pumpsets in the village. A total of 23 diesel pumpsets were installed between 1980 and 1987. Most of these had been bought by farmers already having an electric pumpset. This might have been due to the erratic power supply timings experienced by the villagers. Also, it has been consistently

alleged by the farmers that the total quantum of power supplied to them is not enough to meet their irrigation requirements.

Most of the farmers had availed of loan facility from banks for purchase of the pumpsets. GI pipe was found to be used for the suction and delivery lines by 59 households, while one household used PVC pipe.

Electric power charges were found to be paid by meter except for 2 households who were paying fixed tariff. Fixed tariff was preferred by these households due to the following reasons :

i) There was a continuous menace in the village because of people who tapped electricity from others' mains. The owner of the metered electricity connection invariably paid for much more power than he had actually used. Payment of fixed tariff eliminated this problem of paying more than one's dues.

ii) People who paid by meter had to constantly worry about the reduction in the amount of power they used in order to reduce their electricity bills. Paying at a flat rate in a way encouraged excessive use of power.

The average electricity expenses incurred (as reported by the villagers) on a 3 hp pumpset per year per hp was found to be Rs. 503.00 whereas in the case of 5 hp pumpsets this figure was Rs. 460.00 per hp per year. The overall average, thus came to, about Rs. 2.15 per acre per hp. The average expenditure in case of diesel engine was not determined as most of them were used as stand-by and the expenses incurred by different farmers were different.

Table 3.3.9: Number of pumpsets installed in Dhanawas over the years

S.No.	Year	No. of pumpsets		Cumulative freq.	
		Electric	Diesel	Electric	Diesel
1.	Upto 1964	2	0	2	0
2.	1965-1969	8	2	10	2
3.	1970-1974	17	1	27	3
4.	1975-1979	16	1	43	4
5.	1980-1984	14	12	57	16
6.	1985-1987	6	11	63	27

Persian wheel

Of the existing three persian wheels, only two were found to be in operation and used by the farmers. Persian wheel did not find wide acceptance as an irrigation device since it was time consuming and constant supervision of bullocks is needed.

Water conveyance systems and irrigation methods

The main methods used for water conveyance in Dhanawas were found to be pipes and channels. A majority (about 26) of the villagers used pipes for conveyance of water to the field while 15 households used channels. 10 households conveyed the water to some distance by pipe and then by channels. Sprinklers were used in very few households. The most popular method of irrigation was by furrows.

New installations

An inquest about plans for installation of new pumpsets revealed that 21 households were planning to purchase pumpsets in near

future. Five of these were going in for electric pumpsets and rest of them were preferring diesel pumpsets. This information was obtained in case TERI wanted to initiate work in the improvement of pumpset efficiencies, villagers could be advised on the new installations.

3.3.4 Biomass development

As a part of biomass development activities it was intended to promote agroforestry and wasteland development in the village and also develop a nursery there. Information required for these programmes was collected during the survey.

a) Agroforestry

The survey was used as a means to make the farmers aware of the concept of agroforestry and then find out their willingness to practice it in their field. The set of write-ups given to them on various activities of TERI also included an introduction to agroforestry. This was accompanied by explanations by the investigators.

The results were fairly encouraging and as many as 52% of the farmers showed willingness to try out agroforestry in their fields. Some of the households were hesitant to go in for it as they anticipated problems in ploughing the fields in presence of the plants, though they were explained that the spacing between plants will be sufficient to avoid any such problems. About 4% of the households wanted to have plants only on the boundaries of the fields. Some of them wanted to take it up only after a successful demonstration in others' fields. Table 3.3.9 gives the distribution of willing and non-willing farmers in different

categories. Observations show that farmers in all categories were equally willing to try it out.

Some of the farmers had earlier planted eucalyptus on the boundaries of their fields but found that it affects the soil fertility adversely. Thus they were apprehensive of planting trees with crop. Farmers generally preferred fruit trees or trees with good commercial value.

Table 3.3.10: Farmers' response to agroforestry

Farmers' Category	Total no. of farmers	No. of farmers willing to try agroforestry		No. of farmers willing to plant trees only at the boundaries of fields
		During Demonstration phase	After successful demonstration	
Large	25	15	2	3
Medium	18	9	2	1
Small	25	15	2	-
Marginal	28	11	-	-
Total	96	50	6	4

b) Nursery

As TERI wanted to take up programmes in agro-forestry and wasteland development, having a nursery in the village would have been useful for the programme. Such a nursery could also provide the villagers with plants of their choice. Thus it was decided to first explore through the survey, the interest of the farmers in having a nursery in the village. It was also intended to have the nursery in a private fertile land where facilities for

irrigation were available. Thus the survey also helped in finding out about the people who were willing to give one acre of their land to TERI on lease for the nursery.

Although Haryana Government had also started a nursery on the land of a Dhanawas farmer at the outskirts of the village, it was found that most of the farmers (about 74%) supported the idea of having a nursery in the village. As many as 31 (32%) farmers were willing to lease their land to TERI for nursery development. Discussions with people showed that the Government nursery had failed to make a significant impact as the plants available there were not in demand in the village.

c) **Wasteland particulars**

As an initiation of energy development programme in the village, TERI had started energy plantation in 20 acres of panchayat wasteland in 1985. The objectives of undertaking this project were to develop a source of fuel supply over a period of time and to reclaim the land through tree plantation. A little later, Haryana forestry department also undertook similar programmes in another 20 acre of panchayat wasteland. Considering TERI's interest in reclamation of wasteland, some farmers who owned wastelands, suggested in a committee meeting that TERI should help in reclaiming these individual wastelands as well. Before initiating any work in this area, it was felt necessary to identify the households owning wastelands, to get information about detailed characteristics of their lands and the extent of the households' interest in putting in efforts and money for reclamation of the land.

A total of 136 acre of wasteland was found to be belonging to Dhanawas, which constitutes 17% of total land. 105 acres of this wasteland was owned by village Panchayat and rest belonged to farmers. At present 40 acres is under plantation and 5 acres under lake.

It was found that these lands had become infertile over a period of time due to:

1) Low lying topography due to which they were filled with water during rainy seasons
2) Presence of salts

Out of a total of 12 farmers, who owned wasteland, 4 had made some efforts in its reclamation. They got the soil tested which showed presence of salts (reports of these tests were not available for reference during the survey). They also sought advice from the agricultural departments of the Government and were asked to apply gypsum in these lands every year. However, in spite of the Government subsidy on gypsum, it required high investment and none of the farmers applied it. Despite the salinity of the soil, two large farmers were found to be cultivating their lands regularly. Yield from these lands was less than that from a fertile land. Information on irrigation facilities in the wasteland was also sought as a part of the feasibility requirement for plantations in these lands. Majority of the farmers had a provision for irrigating these lands, due to their location adjacent to fertile lands where borewells were existing. Only three households did not have any irrigation facility.

None of the farmers was found to be aware of experience in wasteland reclamation. However, all the concerned farmers showed interest in getting their wastelands reclaimed by way of growing trees as was suggested by TERI. They were ready to bear a part of total expenditure but also expected TERI to provide some financial support. Though they were interested in growing fruit trees, it was made clear to them that fruit trees could not be grown in wastelands and that species like ramkanti babul, arjun, eucalyptus and bamboo could be used for initial plantations for land reclamation. There was a serious objection from the farmers to eucalyptus plantation, as some of them had had a bad experience with it in their fields.

3.4 Potential for training and employment

As TERI's activities increased in the village and dissemination of various energy efficient technologies was also to be promoted further, it was considered desirable to seek local help in our activities and particularly train some people in the installation and maintenance of different energy devices. To identify people suitable for this purpose, information was obtained about the occupation and interests of all the members of a family above 16 years.

Attempt was made to find out the special skills of people which could be useful to TERI.

The survey showed that as many as 40% of the people were in service or business or were artisans out of which 23% had service or business as the only occupation. Only 10% of the families were landless labourers. People with special skills included masons, carpenters, blacksmiths, mechanics and electricians etc.

It was found that farmers having relatively large land holdings (i.e. large and medium farmers) were engaged in agricultural activities throughout the year as they took two crops. In case of small and marginal farmers many households were not going for kharif crop. These people had a tendency to take up a job in the lean period. Some of them were already engaged in some such work. Those who were free during that period showed interest to work with us.

Other class of people who showed interest to work with TERI were labourers. It was seen that the labour class in the village who did not have enough work throughout the year. They either worked with masons or as agricultural labourer. Due to less agricultural activities in kharif season, they did not always get work in that period. Some of these people also had training as cycle mechanics or thread makers.

Among artisans, there were masons and blacksmiths. Four of the masons could do carpentry as well. Due to less construction work within the village, these people generally went out for work.

Training in biogas

During the survey 45 people showed interest in getting training in biogas. These included masons, labourers and students (Table 3.4.1). Out of these, 39 people were having qualifications ranging from 5th to 12th and training from ITI. While the masons could be trained in construction of biogas plants, students could be trained in their maintenance and monitoring. Some of the labourers with some educational qualification could also be considered for maintenance work.

Table 3.4.1: Number of persons interested in biogas training

Occupation	Number of persons interested	Range of educational qualification
Masons	6	6th - 9th
Labour	16	nil - 10th
Farmers	10	6th - 10th
Students	8	9th - ITI
Unemployed	4	Nil - 10th
Others	1	8th
Total	45	

Training in Nada chulha construction

Since the conventional mud chulhas used for cooking are made by the women themselves, it was decided to explore their interest in the construction of the improved mud-chulha Nada (which had been demonstrated in the village). As generally women only make their own chulha, it was intended to identify those women who would be ready to construct the chulhas in others' houses as well so that they could be used for further dissemination of the chulha in the village and outside.

There was good response with 26 women and girls interested in training. Out of them 11 were willing to work within the village and 15 were ready to even go outside the village (Table 3.4.2).

Table 3.4.2: No. of women interested in NADA chulha training

Economic Category		No. of women willing to work	
		within Dhanawas	other villages as well
Economically Well-off	Large	-	-
	Medium	-	2
	Farmers with other occupation	2	2
	Businessmen/ artisans/ in Service	-	-
Economically Weaker Section	Small/Marginal	4	5
	With other occupation	1	2
	Landless	4	4
Total		11	15

Though for training in biogas and nada chulha construction, it was possible to identify some suitable and interested people, during the survey the survey team did not come across any person, male or female, who was keen to help TERI in its activities.

3.5 General Response to TERI's activities

It was also intended to find out the extent of awareness of our activities and opinion of the people. Suggestions were also sought to increase effectiveness of TERI activities in the village.

The survey showed that almost all households were aware of TERI and its activities, but only 37% of households were aware of the Village Energy Development Committee (Table 3.5.1). There

was a lack of initiative among weaker section to get involved. Reasons identified were:

1) They did not perceive energy as a problem. They were more keen for general development of the village viz. pucca roads, construction of school buildings etc. For the households where energy was a problem in the form of fuel shortage, they wanted fuel rather than an improved chulha.

2) There was an indifference of the people towards any new technology.

3) There was lack of motivation on the part of the committee members to inform all households of our programmes and encourage them to involve themselves.

Most of the households however, including economically backward class were found willing to participate in our activities and attend the committee's meetings. Till the survey, the meetings used to be held in the day time when the committee members were available. But the survey showed that most of the villagers were available only in the evenings. This feedback was useful in furthering our efforts to increase villagers involvement.

In the women's section too questions on their awareness about TERI were included. Again it was seen that most of them knew about TERI's work but almost none of them knew about the committee. They were told about the function of the committee and that they should contact the members in case they were interested in getting any of our devices.

Table 3.5.1: Response of the households towards the committee

Economic		No. of hh. aware about the committee	No. of hh willing to attend committee meetings	No. of hh unwilling to attend committee meetings
Economically Well-off	Large farmers	12	15	4
	Medium farmers	10	16	1
	Farmers with other occupation	8	13	6
	Landless households in service/ Self-employment	5	18	5
Economically Weaker Section	Small/Marginal farmers	11	15	3
	Farmers with additional occupation	1	2	1
	Landless households in service/ self-employment/ labour	6	15	6
Total		53	94	26

The economically weaker households wanted employment instead of improved devices.

During the survey people were also encouraged to give some suggestions to TERI for further work but none of them came up with any concrete ones. Particularly those who realized that TERI was involved in only energy related work, did not suggest anything. However, a few others including women were of the opinion that the village needed general development than installation of energy devices.

4. CONCLUSIONS

In view of its objectives, the AIUN survey proved quite useful in the following ways:

1. In having a direct contact with each household of the village.
2. In determining the level of acceptance of different energy technologies and potential for future dissemination with reference to different households.
3. In understanding the limitations of surveys in collecting data on cattle population, estimation of crop residue.
4. In understanding the villagers' perception of their needs vis-a-vis the energy development activities.

A direct interaction with each household greatly helped in getting a clearer picture of the current pattern of life of different families in the village and scope for carrying out energy development activities among them.

The data collected on different resources and technologies brought into light their qualitative as well as quantitative aspects and gave an insight into whether and how the resource utilization pattern may be changed by promoting suitable technologies.

Among the resources, the village was found to be rich in livestock, with a total of 416 cattle in June '88. Out of different animals, number of buffaloes was found to be the highest. The total cattle population was also found to be decreasing with time. This was particularly true of drought animals. In trading of animals no pattern was observed with respect to different times of the year. Sale and purchase of animals was found to be carried out throughout the year.

Among the cooking fuels, dungcakes and mustard stalk were found to be most widely used. Commercial fuels like kerosene and fuelwood were mainly used by the service class. The village was not found to be having any significant shortage of fuel in summer although about one-third of the families reported facing problems in getting fuel in winter and rainy season.

Data collected on agricultural practices showed a greater utilization of land by small and marginal farmers. All the farmers cultivating their land fully in rabi as well as kharif belonged to this category. Most of large and medium farmers cultivated their land both in rabi and kharif, even though only partially in both the seasons.

As regards, agricultural produce of both grain and residues, the survey clearly showed the unreliability of the data collected by just questioning the farmers. In case of most of the crops except for wheat and mustard data had a large variation and also did not match with the standard figures for that region. While estimates of grain from mustard were also close to the standard figures, the data on mustard stalk was found to be having a very large variation.

Among the technologies, the improved cookstoves were found to have a fairly good acceptance. Most of the households were satisfied with the metal stove TARA, even though they utilized it partially. A large number of households were found to be willing to have Nada Chulha. The women were particularly interested in the smoke removal feature of the chulha. But an improved Hara had a greater potential of impact.

The response of villagers towards biogas technology was slightly lukewarm. Though there was a good potential for family

size biogas plants in the village, most of households were not found to be very keen in getting one installed. It was felt that a greater effort in motivating the villagers before the technology could find better acceptance in the village.

On the other hand, it was felt that biomass development activities had a greater scope for making an impact in the village. Most of the villagers showed an interest in agroforestry and having a nursery in the village. The village had significantly large wasteland. However, the villagers are more keen on trees with more commercial value. With a good number of pumpsets in the village, there was also a scope for initiating work to improve the running efficiency of these pumpsets.

There was also a scope for training some villagers in Nada chulha and biogas construction. As many as 26 women showed interest in getting training in Nada chulha construction. Six village masons were ready to learn the construction the biogas plant. A lot of other people expressed some inclination to get trained for maintenance and monitoring of the plants. However, it was seen that most of these people were more keen to get permanent jobs and hence would not have worked in the village on the voluntary or even temporary basis.

For the villagers getting new energy devices installed was not very important. They did not perceive energy as a problem. For them, general development of the village was more important. Most of them particularly women wanted TERI to undertake general development work for the village. Thus, it appears that a more integrated development approach may be more effective in promoting more efficient energy consumption patterns.

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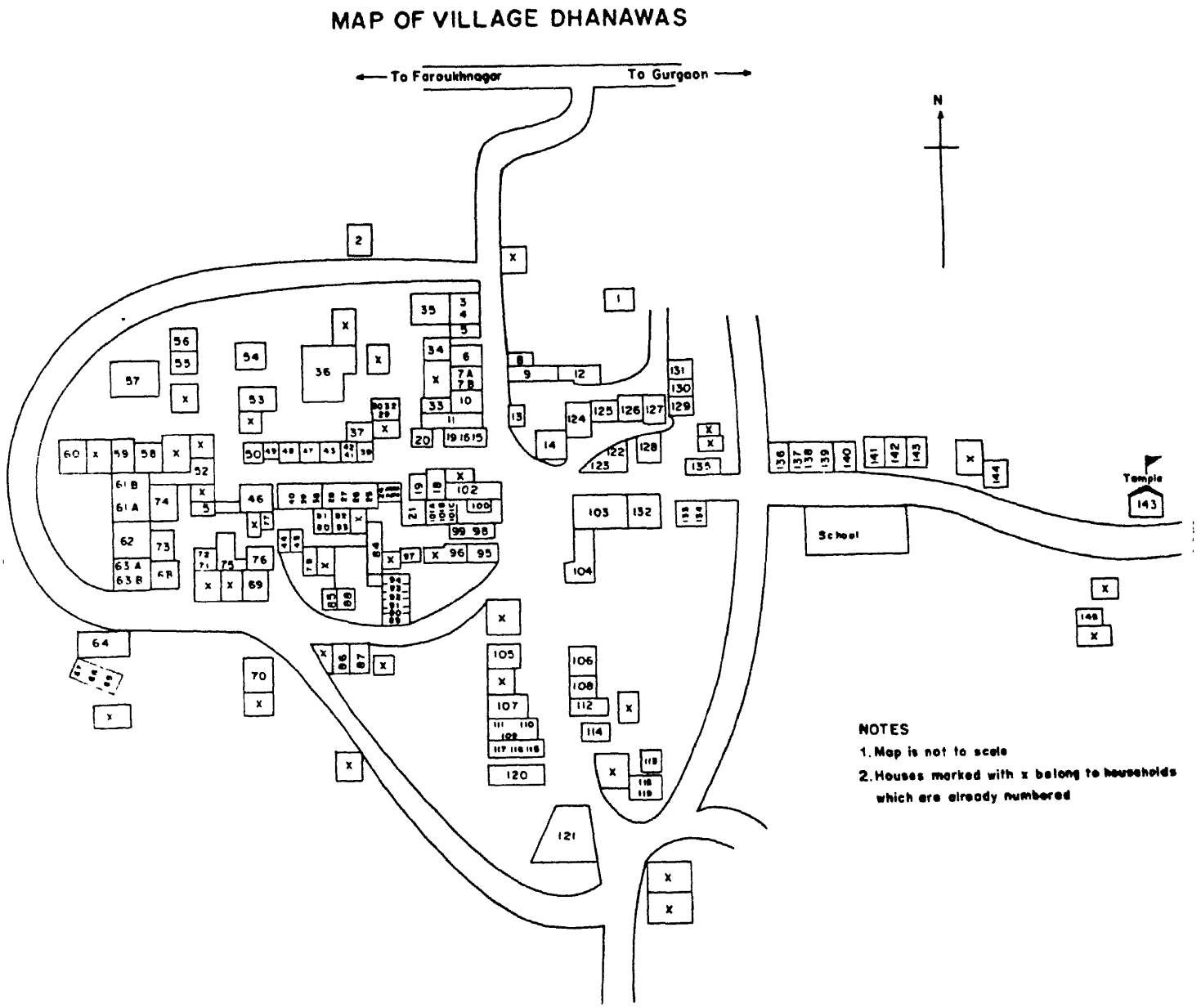
Appendix I

Village Map and the Household List



Household List for Village Dhanawas

Household No.	Name of the Household	Father's Name
1.	Sh. Ganpat	Sh. Rupram
2.	Sh. Manohar Lal	Sh. Sumer Singh
3.	Sh. Patram	Sh. Sundu Ram
4.	Sh. Likhiram	Sh. Phool Singh
5.	Sh. Lakhmi Chand	Sh. Ramdhan
6.	Sh. Badluram	Sh. Layakram
7A.	Sh. Omprakash	Sh. Ramdhan
7B.	Sh. Mehar Chand	Sh. Ramdhan
8.	Sh. Kehar Singh	Sh. Mangal Singh
9.	Sh. Kartar Singh	Sh. Kehar Singh
10.	Sh. Lal Singh	Sh. Sukhdev
11.	Sh. Ramniwas	Sh. Manohar Lal
12.	Sh. Karan Singh	Sh. Challuram
13.	Sh. Narayan Singh	Sh. Hetlal
14.	Sh. Ramesh	Sh. Hetlal
15.	Sh. Mohan Lal	Sh. Bhim Singh
16.	Sh. Sohan Lal	Sh. Bhim Singh
17.	Sh. Prem Singh	Sh. Bhim Singh
18.	Sh. Krishan Kumar	Sh. Rati Ram
19A.	Sh. Khushiram	Sh. Govardhan
19B.	Smt. Sonadevi	W/o Sh. Hari Singh
20.	Sh. Sheeshram	Sh. Kehar Singh
21.	Sh. Ram Kishan	Sh. Siri Ram
22.	Sh. Shadiram	Sh. Ragunath
23.	Sh. Puran Chand	Sh. Raghunath
24.	Sh. Govind	Sh. Raghunath
25.	Sh. Srichand	Sh. Sumer Singh
26.	Sh. Amichand	Sh. Desraj
27.	Sh. Hoshiar	Sh. Desraj
28.	Sh. Hiralal	Sh. Desraj
29.	Sh. Bodan Singh	Sh. Phool Singh
30.	Sh. Rohtas	Sh. Chander
31.	Sh. Chetram	Sh. Chander
32.	Sh. Sukbir	Sh. Chander
33.	Sh. Sher Singh	Sh. Abhay Singh
34.	Sh. Jhamman Singh	Sh. Sukhdev
35.	Sh. Maichand	Sh. Sukhdev
36.	Sh. Chiranjilal	Sh. Mangal Singh
37.	Sh. Krishan	Sh. Likhiram
38.	Sh. Dayaram	Sh. bodhuram
39.	Sh. Bodhuram	Sh. Baklstavar
40.	Sh. Ramavatar	Sh. Bodhuram
41.	Sh. Puran Chand	Sh. Madhuram
42.	Sh. Madhuram	
43.	Sh. Mahavir	Sh. Madhuram
44.	Sh. Sheonarayan	Sh. Bodhan Singh
45.	Sh. Ranbir	Sh. Bodhan Singh
46.	Sh. Raghubir	Sh. Ramjilal

Household No.	Name of the Household	Father's Name
47.	Sh. Chattar Singh	Sh. Sukhdev
48.	Sh. Jaidayal	Sh. Sukhdev
49.	Sh. Balram	Sh. Kashiram
50.	Sh. Siriram	Sh. Ramgopal
51.	Sh. Rohtas	Sh. Sumer Singh
52.	Sh. Jagdish	Sh. Kashiram
53.	Sh. Lakshmi Narayan	Sh. Ganpat
54.	Sh. Ramnath	Sh. Ram Sarup
55.	Smt. Chameli	W/o Late Sh. Dharampal
56.	Sh. Sultan Singh	Sh. Ram Sarup
57.	Sh. Ganpat	Sh. Dolaram
58.	Sh. Baljeet	Sh. Kashiram
59.	Sh. Dhaniram	Sh. Sukhdev
60.	Sh. Chailuram	Sh. Prabhudayal
61A.	Sh. Harchand	Sh. Budhar
61B.	Sh. Satbeer	Sh. Harchand
62.	Sh. Bishen Singh	Sh. Prahlad
63A.	Sh. Ratan Singh	Sh. Chitru
63B.	Sh. Jagram	Sh. Chitru
64.	Sh. Surat Singh	Sh. Lal Singh
65.	Sh. Ramavtar	Sh. Rajaram
66.	Sh. Sriprakash	Sh. Rajaram
67.	Sh. Ramanand	Sh. Rajaram
68.	Sh. Parmanand	Sh. Kanshiram
69.	Sh. Omprakash	Sh. Deepchand
70.	Sh. Babulal	Sh. Deepchand
71.	Sh. Jaikishan	Sh. Kanshiram
72.	Sh. Kanshiram	Sh. Lekhram
73.	Sh. Bharat Singh	Sh. Prahlad
74.	Sh. Mir Singh	Sh. Prahlad
75.	Sh. Ram Narayan	Sh. Bhakturam
76.	Sh. Ishwar	Sh. Surat Singh
77.	Sh. Balwant Singh	Sh. Sumer Singh
78.	Sh. Sirichand	Sh. Dungar Singh
79.	Sh. Gian Chand	Sh. Umrao
80.	Sh. Satpal	Sh. Balwant Singh
81.	Sh. Balant Singh	Sh. Summer Singh
82.	Sh. Umrao	Sh. Mohar Singh
83.	Sh. Ramavtar	Sh. Umrao
84.	Sh. Omprakash	Sh. Mohar Singh
85.	Sh. Itbari	Sh. Kesala
86.	Sh. Dayanand	Sh. Itbari
87.	Sh. Juglal	Sh. Bhunderam
88.	Sh. Bishambar	Sh. Bhunderam
89.	Sh. Kudiaram	Sh. Ramkaran
90.	Sh. Khemchand	Sh. Ramkaran
91.	Sh. Ram Singh	Sh. Ramjilal
92.	Sh. Ramnath	Sh. Ramjilal
93.	Sh. Banwarilal	Sh. Nathuram
94.	Sh. Chimanlal	Sh. Rampath

Household No.	Name of the Household	Father's Name
95.	Sh. Tejram	Sh. Mehar Chand
96.	Sh. Shesh Ram	Sh. Mehar Chand
97.	Sh. Ramesh	Sh. Chitroo
98.	Sh. Ishwar Singh	Sh. Mehar Chand
99.	Sh. Trikaram	Sh. Mehar Chand
100.	Sh. Omprakash	Sh. Sheonath
101A.	Sh. Sheocharan	Sh. Madhu Ram
101B.	Sh. Sheonarayan	Sh. Madhu Ram
101C.	Sh. Ramniwas	Sh. Madhu Ram
102.	Sh. Ratiram	Sh. Govardhan
103.	Sh. Guggan Singh	Sh. Ramji Lal
104.	Sh. Chand Singh	Sh. Ramchandar
105.	Sh. Jailal	Sh. Umrao
106.	Sh. Sher Singh	Sh. Sheoram
107.	Sh. Sajjan Singh	Sh. Dulichand
108.	Sh. Mangal Singh	Sh. Mussan
109.	Sh. Tularam	Sh. Roshan lal
110.	Sh. Jagroop	Sh. Tularam
111.	Sh. Sartaj	Sh. Tularam
112.	Sh. Chandgiram	Sh. Nathuram
113.	Sh. Sheshram	Sh. Nathuram
114.	Sh. Tarachand	Sh. Harinarayan
115.	Sh. Puran Chand	Sh. Bhonduram
116.	Sh. Munshiram	Sh. Bhonduram
117.	Sh. Angrez	Sh. Bhonduram
118.	Sh. Rajpal	Sh. Ram Sarup
119.	Sh. Bastiram	Sh. Ram Sarup
120.	Sh. Ishwar Singh	Sh. Nandram
121.	Sh. Kushiram	Sh. Govardhan
122.	Sh. Kishanlal	Sh. Siriram
123.	Sh. Moolchand	Sh. Bhani Sai
124.	Sh. Mangtaram	Sh. Prem Raj
125.	Sh. Hoshiar Singh	Sh. Prem Raj
126.	Sh. Bharat Singh	Sh. Prem Raj
127.	Sh. Bhavaniram	Sh. Mangturam
128.	Sh. Jagmal	Sh. Sumer Singh
129.	Sh. Mangeram	Sh. Sahjad
130.	Sh. Gopiram	Sh. Sahjad
131.	Sh. Gugganram	Sh. Sahjad
132.	Sh. Hariram	Sh. Sahjad
133.	Sh. Ramesh	Sh. Hukamchand
134.	Sh. Chatter Singh	Sh. Hukamchand
135.	Sh. Ramniwas	Sh. Sahjad
136.	Sh. Harprasad	Sh. Ramjeevan
137.	Sh. Hardatt	Sh. Balakram
138.	Sh. Phool Singh	Sh. Nawal Singh
139.	Sh. Lalaram	Sh. Chitroo
140.	Sh. Ramkumar	Sh. Dulichand
141.	Sh. Phool Singh	Sh. Sirichand
142.	Sh. Rajkanwar	Sh. Sirichand

Household No.	Name of the Household	Father's Name
143.	Sh. Sheocharan	Sh. Sirichand
144.	Sh. Bhairam	Sh. Bhani Sai
145.	Sh. Tejram	Sh. Sirichand
146.	Sh. Gian Chand	Sh. Chitroo
147.	Sh. Kartar Singh	Sh. Bhunderam
148.	Temple	

Note: Household numbers 19A, 37, 42, 77 and 80 have not been considered as houses.

Household numbers 11, 40, 61A, 63A and 72 have been considered as separate houses for sections on cooking fuels and improved chulhas. For all other sections, these households have been combined with household numbers indicated against them.

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Author

Title

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